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APR 6 1945

CIVIL ENGINEERING

Published by the American Society of Civil Engineers

CLIMAX OF THE ENGINEER'S WORK IN ASIA—OPENING OF THE STILLWELL ROAD

Volume 15 — *Number 4*

APRIL 1945

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Among Our Writers

EUGENE REYBOLD (U. of Del., B.C.E., '03), D.S.M. in World War I, has served in the Coast Artillery and Corps of Engineers in grades from 2nd lt. to maj. gen. In 1937 he gained national recognition for handling a Mississippi River flood crisis. In 1940 he became Asst. Chief of Staff in Charge of Supply, and later assumed his present office of Chief of Engineers, administering the largest construction program in history.

HAL H. HALE (U. of Tenn.) was employed by the city of Knoxville, Tenn., for more than 10 years, about half that time as city engineer. After a short period with the TVA, he was office engineer for the Atlanta district, Portland Cement Assoc. From 1941 until recently he was the Society's Washington (D.C.) representative. He is now executive secretary, Amer. Assoc. of State Highway Officials.

WILLIAM H. SMITH, Captain (CEC) U.S.N. (M.I.T. '15), has been in the Civil Engineer Corps since 1917, in charge of many important works, including design of the Navy's first floating drydock and the New York Navy Yard's 15-million-dollar expansion program. In 1943 he became Director, Planning and Design Dept., Bureau of Yards and Docks, and in addition was recently designated Chief Planning Officer of the Bureau.

GAYLE McFADDEN (Ala. Poly. Inst. '14) after 12 years in consulting practice, joined the U.S. Engineer Dept. in 1932. He was in charge of the construction of La Guardia Airport in New York, Chief of Operations for all work by the U.S. Engineers at the Washington, D.C., National Airport, and is now Civil Engineering Consultant and Chief of Runways, Roads and Railroads Section, Military Construction Branch, Engineering and Development Div., Office, Chief of Engineers.

JOHN P. HOGAN served overseas with distinction during World War I, becoming lieutenant colonel on the general staff. In 1926 he became a member of the firm of Parsons, Klapp, Brinckerhoff and Douglas—now Parsons, Brinckerhoff, Hogan & Macdonald. This firm has been active in war work on Navy bases, etc. Mr. Hogan has served as Director, Vice-President, and President of the Society.

GEORGE MAYO (U. of Calif., B.S. C.E. '11) started his service in the Corps of Engineers during the punitive expedition to Mexico. He has served as District Engr. at Portland, Ore., and Asst. to the Division Engr., North Atlantic Division. In the present war he has been Chief Engr. of the Caribbean Defense Command, and since 1943, Air Engineer to the Army Air Forces.

A. PRESCOTT FOLWELL, JAMES B. FRENCH, ANDREW J. PROVOST, JR., and T. KENNARD THOMSON are Society members of long standing. The interesting account of their trip to Europe in 1889 under Society auspices began in the January issue, in which appeared also brief biographical accounts of all four co-authors.

R. C. SWEENEY (Mich. State Col., chemical eng. '19) had done responsible sanitary work for the Ohio Dept. of Health, and for Toledo and Springfield, Ohio, when he entered the Army in 1941. He has served in England, Africa, Italy, and France. Recently, as Lt. Col. (San C), he returned to the Office of the Chief Surgeon, ETO, as Senior Sanitary Engr.

J. C. STEVENS (U. of Nebr., '05; C.E., '28), President of the Society, maintains a consulting practice in Portland, Ore. He is also a manufacturer of engineering instruments.

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VOLUME 15 NUMBER 4

April 1945

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Printed in U. S. A.

Entered as second-class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1102, Act of October 3, 1917, authorized on July 5, 1918.

CIVIL ENGINEERING

Published Monthly by the
AMERICAN SOCIETY OF CIVIL ENGINEERS
(Founded November 5, 1852)

PUBLICATION OFFICE: 20TH AND NORTHAMPTON STREETS, EASTON, PA.
EDITORIAL AND ADVERTISING DEPARTMENTS:
33 WEST 39TH STREET, NEW YORK

This Issue Contains

ENGINEERS IN THE DRIVE TO VICTORY 157
Eugene Reybold

HIGHWAYS—MAJOR POSTWAR PUBLIC WORKS 161
Hal H. Hale

WATER SUPPLY ON THE BATTLEFRONT 163
William H. Smith

EVALUATION OF LOAD-CARRYING CAPACITIES OF MILITARY AIRFIELDS 167
Gayle McFadden

THE FUTURE OF AMERICAN ENGINEERS IN SOUTH AMERICA . . . 170
John P. Hogan

AIRFIELDS "CUSTOM BUILT" BY AVIATION ENGINEERS 173
George Mayo

ENGINEERS' ODYSSEY TO EUROPE—1889. IV. Paris and Its Exposition 177
A. Prescott Folwell, James B. French, Andrew J. Provost, Jr., and *T. Kennard Thomson*

REFUSE DISPOSAL IN NAPLES AFTER ALLIED OCCUPATION . . . 180
R. C. Sweeney

PROPOSED SUBSTITUTE FOR RIVER VALLEY AUTHORITIES 182
J. C. Stevens and *W. W. Horner*

ENGINEERS' NOTEBOOK
Blasting Necessary in Dismantling Bombproof Power Station . 183
Bernard R. Cordes

Red Ball Highway—Artery to Western Front 184
George H. Barton

SOCIETY AFFAIRS 186

ITEMS OF INTEREST 197

NEWS OF ENGINEERS 201

DECEASED 202

CHANGES IN MEMBERSHIP GRADES 14

APPLICATIONS FOR ADMISSION AND TRANSFER 18

ENGINEERING SOCIETIES' PERSONNEL SERVICE 22

RECENT BOOKS 22

CURRENT PERIODICAL LITERATURE 24, 26, 28, 30

CATALOG DIGEST SERVICE 32, 34, 36, 37, 38, 40, 42, 44, 48

INDEX TO ADVERTISERS 50

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SUBSCRIPTION RATES

Price 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

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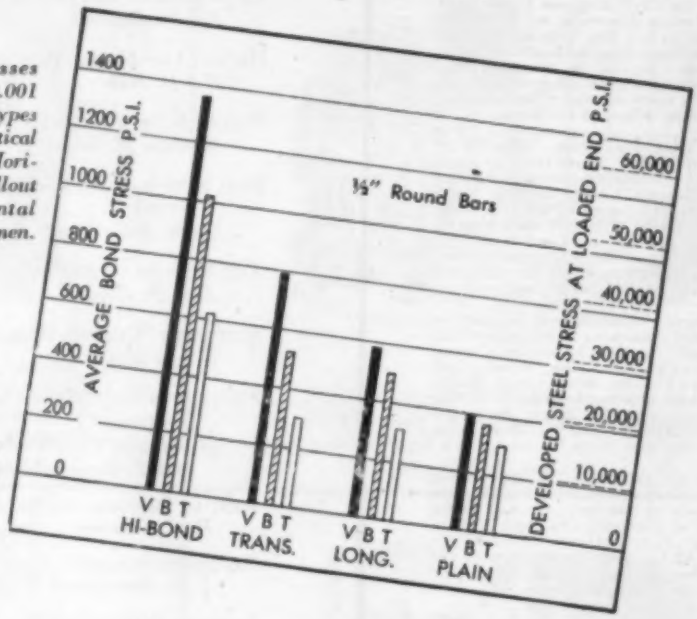

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Volume 15 — April 1945 — Number 4

Engineers in the Drive to Victory

Permanent Organization Proves Versatile in Greatest of Construction Programs

By Eugene Reybold, M. Am. Soc. C.E.
Major General, U.S. Army; Chief of Engineers, Washington, D.C.

A RECORD of solid accomplishment has been made by Army Engineers as their work has carried them from an unprecedented construction program in the U.S.A. to the continuing struggle on the fighting fronts. Timber, steel, concrete, and earth—they can be made to serve the Engineers regardless of location or circumstances. Literally, as General Reybold shows, they have changed the face of the earth from Mobile to Manila and from Austin to Aachen. This address was presented before the District of Columbia Section of the Society.

ANY report of the role in this war played by American engineering in general, and by our Army Engineers in particular can best be covered in three parts: the work of engineers in the build-up for war, in turning the tide of war, and in the drive to victory. Never before have engineering responsibilities been of such scope and variety, and never before has American engineering genius been demonstrated on such a world-wide scale.

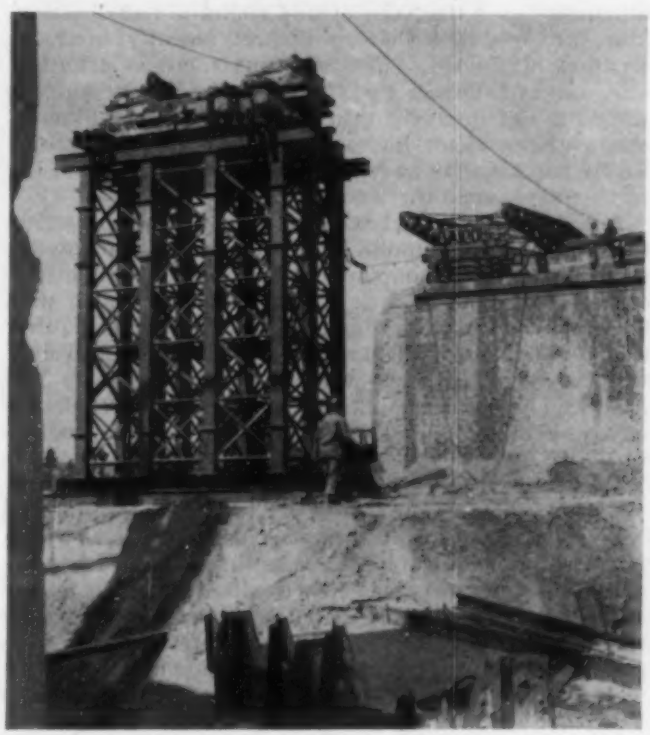
During the early days of the war, our primary objective was to complete the emergency construction program at the earliest possible date. That program was the very cornerstone in building up our military strength. We could not train great numbers of men and we could not produce great quantities of munitions until this vast construction program was in place. The range of engineering and construction specialties called upon to build everything from airdromes and seacoast batteries to chemical warfare and munitions plants, from troop cities to ports of embarkation, made it necessary for us at that early period of the war to marshall much of the engineering and construction talent of America.

By the summer of 1942, we were in the midst of a program that was putting $20,000,000 worth of new construction into place every day. We were acquiring the vast acreages of land and other real estate necessary for such a program. At no previous time in history had any one agency been called upon to supervise as large and as effective an army of building-trades workers and executives as the Corps of Engineers directed at the peak of that eleven-billion-dollar program. The civilian engineering profession and construction skills of this country contributed magnificently and wholeheartedly to the success of that tremendous undertaking.

SKILLED SPECIALISTS

In 1943, we undertook a job that was a natural sequel to the domestic construction achievement—the recruiting from the ranks of the construction industries and engineering professions of skilled specialists for military duty. War construction was moving in greater volume overseas. Facilities had to be prepared for the housing and movement of millions of men and their supplies and equipment in battle zones around the world. These specialists were needed to fill key jobs in the troop organizations we were training to carry on overseas this job of building great bases from which to launch our attacks against the enemy. We got those men. And they are giving a good account of themselves in the fields of action wherever they are.

The problem of keeping our Engineer troops overseas supplied with the superior types of American engineering equipment was becoming an increasingly important and extensive responsibility. Everywhere, today, as our forces go forward from Engineer-built bases, over Engineer-built roads and bridges and railroads and docks, this equipment is recognized as a significant element in our



Under Fire, the Engineers "Make Smooth the Way" for Advancing Forces—A Standard Unit Steel Pier

EQUIPMENT AND PLENTY OF IT MADE THE WORK IN THEATERS OF OPERATION POSSIBLE

superiority over the Axis. One Ground Forces observer, from the Southwest Pacific, declared recently, after the invasion of Leyte: "The war out there is a supply war and an Engineer's war—and we had more supplies and more Engineers than they had." And a well-known war correspondent has said: "In Western Europe, American engineers and American machines grasped the earth and changed the face of it."

American industrial labor and management are seeing that we get the supplies and machines. We are responsible for such equipment as tractors and bulldozers, cranes and shovels, rock crushers and sawmills, pipe lines and water purification units, and thousands of other items. Supplies of this kind will be required until final victory over Japan as well as over Germany. The American equipment industry is meeting its challenge in a way that is characteristic of the American will to win.

TOUGH SCHEDULES MET

While we have achieved these goals in our step-by-step program of helping build a substantial basis for complete Allied victory, we have realized that the major requirement is the determined drive to bring the war to a speedy and decisive end—a complete and crushing end. What we did during those earlier months of the war may be called the "build-up." Tough schedules had to be met during that period. But the tempo and pace of the build-up must be increased to an intensity and fury that our enemies cannot possibly match. This phase of the war we may characterize as the "speed-up"—and that, too, has to be carried out on schedule. In the last 21 months, for instance, we increased the number of Engineer troops overseas by more than 350%. We have consistently increased the flow of equipment, parts, and supplies to those troops.

To date more than a half-million Engineers have been trained, including over 20,000 officer candidates and many thousands of technicians in more than 250 specialties from instrument repairmen to sawmill operators—from divers to well drillers. This training program required careful planning and the establishment of large training centers as well as civilian schools, and many engineers and civilian agencies have assisted us in this task.

As the horizons of engineering responsibility in the war were extended, we found the Corps of Engineers building the Alaska Highway, the Pan-American Highway, the supply line across Iran, the Ledo Road in Burma, and bases along 56,000 miles of supply routes all over the world. The engineering and construction that developed our bases and ports and airfields in the Aleutians were largely responsible for blocking Japan's thrust over that route.

When we stopped the spread of the Japanese in the Southwest Pacific, stopped it and turned it back, in the early days of 1942, we held superiority in only one department—our engineering ability. In saying this, I am not depreciating the gallant sacrifices and the indispensable elements of our air, ground, and sea forces. But at that time the enemy had superiority in the number and quality of his planes, and his navy was definitely superior in numbers to anything we could muster in the area. But he was distinctly inferior in his ideas and execution of engineering works. He contented himself with picayune installations that were incapable of supporting the major forces he would need. He built neither roads nor piers, while he hung his airfields as close to the beach as high tide would permit.

As a direct result, his planes were caught concentrated in one or two strips and burned out, and his supplies were not in sufficient quantity to permit him to live on his reserves when his shipping was sunk. Great credit is due the five Engineer units that built many airdromes in three months in northern Australia, and changed New Guinea from jungle-covered mountains to a series of major towns. From Friday noon to Tuesday dawn, they changed a gum forest into a 7,000-ft runway with planes operating on it. They provided the air strip at Milne Bay; they developed Port Moresby. They bulldozed hundreds of miles of roads in Australia, New Guinea, and other South and Southwest Pacific islands.

PUSH THEM FORWARD

Other Engineers performed similar miracles in building airdromes and roads and port facilities in North Africa. After the invasion that started the turn of the tide against the Germans in the Mediterranean area, adequate air cover was impossible because of a lack of landing fields. Within a few short weeks, however, the

CONSTRUCTION OF THE WORLD'S LARGEST FACTORIES MARKED THE FIRST STAGE OF ENGINEERING OPERATIONS

northern coastline of Africa was ringed with landing fields; and these fields crept forward like an artillery barrage, putting bases closer and closer to the German Afrika Korps. Construction paced the drive of our forces across Sicily and Italy.

For two years before the invasion of Normandy, Engineers worked night and day to make that mammoth operation possible. It began with the preparation of bases in the British Isles, where more than 100,000 buildings were constructed or acquired in 1,100 towns and villages, where the Engineers built troop cities and roads, and hundreds of miles of airfield taxiways and runways.

For two years the Engineers were gathering the terrain intelligence necessary for the invasion and subsequent operations, and were preparing the maps for the use of all the invading forces. We had to know the character of the beaches where we would land and just where the tides would be at each given instant. We had to know where roads could be built away from the beaches, where supply dumps could be located, and where airfields could be built. We had to estimate the damage to ports and to railroads and to public utilities and to bridges, and had to assemble the materials and equipment for their repair.

PONTOON BRIDGES WERE NEEDED ON THE LEDO ROAD FOR CROSSING MONSOON TORRENTS

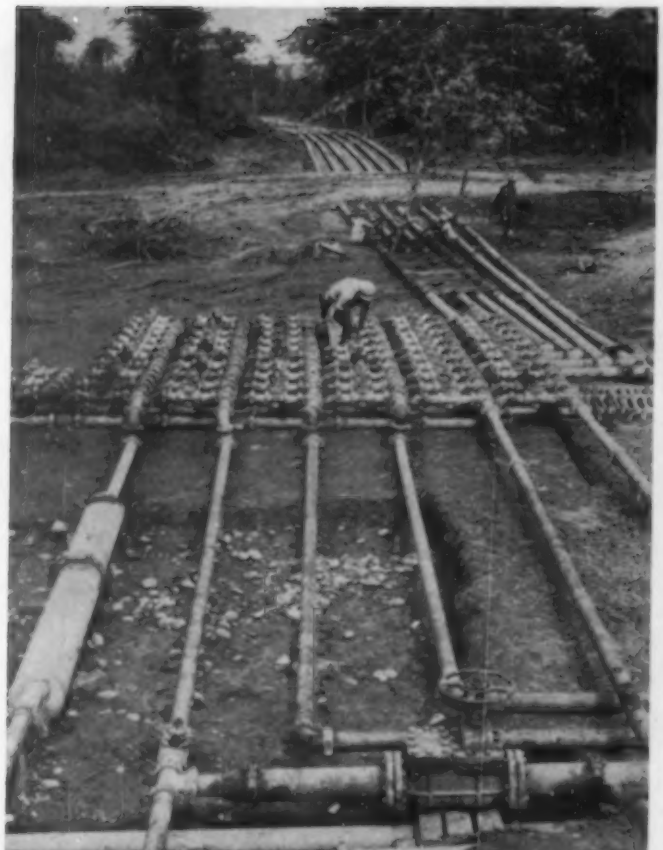
These are some of the activities of the Engineers in the Pacific and in Europe that helped to turn the tide of war. These were some of the turning points that helped to start us on our drive to victory.

Broadly speaking, it is the mission of the Engineers in a theater of operations to keep the armies on the move and the supply lines open. Some fifty different kinds of Engineer troop units perform a wide range of specialties, serving in every major component of the Army Air Forces, the Army Ground Forces, and the Army Service Forces.

ON THE BEACHES

I have in mind one Engineer combat regiment which has every right to consider itself one of the most versatile troop units in the Army. This particular regiment has been trained and organized as an Engineer shore regiment. Its primary mission is the back-breaking, but absolutely vital, job of organizing an invasion beach as a supply headquarters for the push inland. This particular regiment has spearheaded every landing our forces have made in the North African and Mediterranean theaters. On the beaches at Gela, Sicily, this outfit proved that a major campaign can be supplied without the benefit of port facilities. The Germans in Normandy should have remembered that lesson!

At Salerno, the same Engineer regiment won the admiration and respect of all who watched it stick to that slender beachhead—continuing to move supplies ashore until our toehold could be made secure. At Anzio, the regiment again led the way—and there, for approxi-



VERSATILE ENGINEERS BUILT AND OPERATED GASOLINE PIPE LINES IN INDIA-BURMA-CHINA THEATER

mately 50 days without relief, it fought as infantry to hold a section of the beachhead perimeter. This regiment again set up the American beachhead in Southern France in the invasion which has been described as a model for major amphibious landings. With the beachhead secure, the Engineers from this regiment helped to restore enough port facilities at Marseilles to keep up the flow of supplies to the armies pressing northward. This Engineer regiment has already sustained more than twice its total original strength in casualties. Its record is heroic proof that Engineers fight as well as build—and they are staying with their job.

PRIDE OF OUTFIT

These men are motivated to make such sacrifices by more than mere individual self-respect. They are personally convinced that the best way to shorten the war is to get along with it and they are spurred on by a feeling that is common to all good soldiers. We call it "pride of outfit." They can take anything the war can dish out to them. That is the spirit that makes the American Army a great fighting machine. Such teamwork will win overwhelmingly.

Perhaps it is not inappropriate, therefore, for me to express publicly to engineers the deep personal gratitude I feel for the "pride of outfit" shown by all those who work together under the Engineer flag. Our civilian and military personnel throughout the country are sticking to the job in a way that is a tribute to American manhood and womanhood. The test of war has proved the soundness of our permanent organization. Specializing through peacetime years in river and harbor and flood control work, we had an administrative organization which took in stride the challenge of planning and supervising history's greatest construction program.

The same organization has been versatile enough to handle the unprecedented task of procuring, storing, and issuing Engineer equipment and materials. It has handled the procurement of millions of acres of land and millions of square feet of floor space. It has handled the repairs and utilities program—the city-management function—at hundreds of posts, camps, and stations. It has provided Engineer training techniques and materials, and has supplied maps by the hundreds of tons for all branches of the Army.

WHEN PEACE COMES

Thus I know that, when the challenge of war is succeeded by the responsibilities of peace, the Army Engineers will be ready to resume the mission they have performed during years of peace for more than a hundred years—the river and harbor program for the nation. We will not have to build a new organization. We have our organization.

But today as our troops are inching their bloody way through the rain and fog and snow and mud toward the heart of Germany, and over land, sea, and by air to Japan, we have grim evidence that the victorious conclusion of this war remains a grave and tremendous undertaking. Our active battlefronts now extend from the borders of Germany and from the Philippines right back to the farms and forests and mines that supply the raw materials for our war industries. Pressure on these fronts, both at home and overseas, must be maintained constantly—must be steadily increased. Any act or deed that delays production or transportation or any other essential service cannot help but increase the awful price of victory. Over-optimism and complacency will be paid for in terms of American lives. Today, more than three years after the first unprovoked and savage attacks on American life and property, let us renew our pledge to continue to use whatever forces we have at our command to free the world from the evil powers that seek to destroy it—to open up the long, tough roads to Berlin and Tokyo—to win total victory and peace.

A WORTHY TRADITION

Let us as engineers maintain the tradition so aptly expressed by Sergeant Harry Brown, author of "A Walk in the Sun," when he said:

You can trace our fighting history through a hundred thousand years,
For when they needed barricades they sent for Engineers.
It was a very hairy, early soldier of the Corps
Who discovered bows and arrows and learned what rocks are for.
We built the horse that got Troy gigged when Homer was a pup,
And we ran ahead at Marathon and tripped the Persians up.
When Caesar crossed the Rubicon as he was going home,
We put a bridge across the stream and changed the course of Rome.

Napoleon at Waterloo might still have held the field
If he had had ten Engineers to keep old Blucher heeled.
Or Wellington, had we been there instead of his array,
Would have taken half an hour to win instead of half a day.
O, some of us are bourbon men and some of us drink wine,
And there's more meat in front of us when we sit down to dine.
O, when the average cannoneer goes down to hell in tears,
He'll find the Styx and Phlegethon were bridged by Engineers.

Highways—Major Postwar Public Works

Need for More Planning Stressed in Address Before Highway Division at Society's Annual Meeting

By HAL H. HALE, M. AM. SOC. C.E.

EXECUTIVE SECRETARY, AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, WASHINGTON, D.C.

THREE years of war have taken a serious toll of the highways and facilities in every part of the nation. Against the wartime arrearages in maintenance and construction, the postwar period looms both as a challenge and as an opportunity.

Highway work, as in the past, will then constitute an important part of the total construction activity which will be at once necessary and desirable in meeting the needs of demobilization, industrial reconversion, and the reestablishment of peaceful pursuits. The magnitude of the part that highway construction will play in the future scheme can best be demonstrated by reference to what occurred in this field before the war.

In the 21-year period from 1920 to 1940, inclusive, highway construction provided almost precisely half of the total dollar volume of all public construction undertaken, inclusive of work relief expenditures during the depression. In the same period, public construction formed about one-third of the total volume of all construction activity. In no three-year period did the average of highway construction, as a percentage of the average of all public construction, fall below 45%, or exceed 54%, as shown in Table I.

In the stability of the proportions of highway construction there shown, there is decided significance. These data reflect the relative need for highway works and for other forms of public works, and provide ample reason for the belief that these relationships will continue in the future—highway construction as one-half of public construction, and public construction as one-third of total construction.

TABLE I. PROPORTIONS OF HIGHWAY WORK IN PUBLIC WORKS (INCLUDING WORK RELIEF) AND TOTAL CONSTRUCTION VOLUME

Annual Averages in Millions of Dollars

PERIOD	TOTAL CONSTRUCTION	PUBLIC CONSTRUCTION			PUBLIC AS % OF TOTAL	HIGHWAYS AS % OF PUBLIC
		Total	Highway	Other		
1920-22	6,207	1,514	777	737	24.4%	51.3%
1923-25	9,429	1,856	930	926	19.7	50.1
1926-28	10,838	2,314	1,166	1,148	21.4	50.4
1929-31	8,256	2,588	1,351	1,237	31.3	52.2
1932-34	2,968	1,729	923	806	58.3	53.4
1935-37	4,427	2,658	1,225	1,433	60.0	46.1
1938-40	5,913	3,465	1,559	1,906	58.6	45.0
1920-40	6,863	2,303	1,133	1,170	33.6	49.2

Further evidence of the soundness of this long-time relationship is shown by the Report of Proposed Postwar Public Works prepared by the Federal Works Agency in collaboration with the Bureau of the Census, at the request of the Special Committee on Postwar Economic Policy and Planning, House of Representatives. This report gives the volume and status of plan preparation proposed by state and local governments as of July 1, 1944. Table II has been condensed from the report.

In each of the four stages of plan preparation, the planned highway projects approximated one-half of the total planned public works. In the first two most significant stages of plan preparation, "completed" and "under design," planned highway construction was 49.2% of the total of planned public construction—the identical percentage which has held for highway construction in all the actual public construction carried out during the 21-year period from 1920 to 1940.

As a firm basis for the preparation of adequate postwar highway plans, the rational estimation of postwar highway needs is imperative. These needs will be made up of the normal degree of operation comparable to the average volume attained in the prewar years and an additional activity designed to make up the arrearage of work deferred because of the war. In order to estimate the volume of required postwar highway work in terms of dollars, it is necessary to make an assumption as to the postwar purchasing power of the highway dollar. If it may be assumed that the return to more normal conditions will reverse the trends of the period just before our entrance into the war, then the period 1940–1941 may be considered to represent a close approximation of the conditions to be expected in the postwar years. On this assumption, prewar and wartime average highway expenditures have been converted to 1940–1941 levels. Average annual expenditures in all jurisdictions, thus computed for the prewar period from 1936 to 1941, amounted to 2,037 million dollars—1,432 millions for construction and 605 millions for maintenance. During the war period from 1942 through 1944, the corresponding average annual expenditure was 777 million dollars—358 millions for construction and 419 millions for maintenance.

TABLE II. PROPOSED POSTWAR PUBLIC WORKS—REPORT PREPARED AT REQUEST OF SPECIAL COMMITTEE ON POSTWAR ECONOMIC POLICY AND PLANNING

STAGE OF PLAN PREPARATION	ESTIMATED COST (MILLION DOLLARS) OF PUBLIC CONSTRUCTION			HIGHWAYS AS % OF TOTAL PUBLIC
	Total	Highway	Other	
Completed	1,189	488	701	41.0%
Design	2,707	1,429	1,278	52.8
Preliminary	4,720	2,125	2,595	45.0
Idea	8,717	4,239	4,478	48.6
Total	17,333	8,281	9,052	47.8%

The difference represents the average annual arrearage expressed in assumed postwar values incurred during three war years. Not all of this will need to be made up, since a considerable part of the reduced maintenance expenditure represents neglect of operations, the effect of which will be obliterated on resumption of normal maintenance. Still another part may be avoided by reconstruction, which will take the place of extraordinary maintenance. Also, some arrearage embodies merely a reduction in the standard of service rendered. It is believed that all the construction arrearage and approximately half of the maintenance arrearage may be taken as a reasonable approximation of the work that must be made up in the postwar period in addition to resumption of the normal program.

There is no rigidly fixed period during which these arrearages will need to be made up, but emphasis will necessarily be placed on quick inception of a very large program to employ as much as possible of the available manpower during the period of reconversion and adjustment. Incurred in three years, the arrearage may well be offset in three years, and if this is done, the annual post-

war volume of highway activity will approximate 3,202 million dollars—2,506 millions for construction and 696 millions for maintenance.

The magnitude of this operation and the obstacles in the way of its expeditious accomplishment are not realized as they should be in each and every highway jurisdiction. In all highway jurisdictions, it represents an increase over normal of 75% in construction and 15% in maintenance. It means rapid expansion to an employed force of more than a million men, and the continuous employment of this number at the site for at least three years. Of these, 600,000 will be needed on construction and 423,000 on maintenance.

Broadly construed, planning for these postwar needs includes more than the engineering surveys, designs, plans, specifications, and estimates. It includes the necessary preliminaries to actual contract awards involved in the acquisition of rights of way, together with all necessary state legislation to authorize expeditious and adequate provision for limited-access construction, particularly in urban work, and for authority to provide and protect related highway facilities.

The planning of projects to safeguard high standards of construction, the provision of legislative authorization, and the final steps to assure a steady flow of projects into construction status, all do now, and will continue to require a broadened concept of federal-state and state-local relationships among highway administrative authorities. They also demand an expanded employment of professional personnel by both public and private consulting agencies, and the continued provision of adequate funds for financing planning operations at federal, state, and local levels.

HALF OF PROJECTS LOCAL

The cost of the highway and street improvements proposed for postwar construction by all highway agencies amounts in the aggregate to $8,281,000,000 as of July 1, 1944. Of this, approximately half, or $4,707,000,000, represents proposed federal-aid and state highway projects. No continuing record is available on planning by local highway agencies, but the progress made in the preparation of plans for federal-aid and state highway projects is recorded through a procedure of regular reporting to the Public Roads Administration by all the state highway departments. The following tabulation shows the estimated construction costs for the first three stages of plan preparation as of April 1 and November 1, 1944, and reveals the progress made in the interval:

State of Plan Preparation	Estimated Construction Costs	
	Apr. 1, 1944	Nov. 1, 1944
Surveys and plans:		
Completed	$ 200,201,000	$ 368,971,000
Under way	821,500,000	2,060,194,000
Not under way	1,036,391,000	1,078,457,000
Total	$2,058,092,000	$3,507,622,000

This table shows that the states have made a substantial advance, amounting in seven months to an increase of 84% in the completed stage, 51% in the under-way stage, 4% in the not-under-way stage, and 70% in the total. Notwithstanding this advance by state highway agencies, much remains to be done, and there is considerable evidence of lagging behind in other local agencies. Progress in the allotment of funds, making of field surveys, and preparation of plans has been unavoidably delayed by several causes. The primary one has been the heavy loss of trained engineering personnel by all public highway agencies and the preoccupation of the remaining forces with the care of essential roads. Uncertainty as to the date of the war's end has contributed to delay, but the obstacle represented by the uncertainty as to the amount of federal funds to be made available and the conditions attached to their expenditure has been definitely removed by the recent passage of the Federal-Aid Highway Act of 1944.

CITIES' NEEDS TABULATED

Of the total program estimated to be needed in each postwar year, the requirements for urban work constitute about 27%, estimated in dollar value at 711 millions for construction and 167 millions for maintenance. This is the overall measure of urban need involving projects which will be constructed both with federal and state aids and with independent funds from urban sources to the extent possible and feasible in the postwar period. Against that need, the current planning status (November 30, 1944) of urban highway construction projects involving or expected to involve federal and state funds is shown in relation to the total of state highway planning as follows:

State of Plan Preparation	Estimated Construction Cost (Thousands of Dollars)		
	Urban	Rural	Total
Surveys and plans:			
Completed	57,128	311,843	368,971
Under way	697,366	1,362,828	2,060,194
Not under way	254,187	824,270	1,078,457
Total	1,008,681	2,498,941	3,507,622

In the aggregate, plan preparation for urban highways and streets consists of about 29% of the total, and compares favorably with the relative advancement of planning in other jurisdictions. In the provision of urban planning, the state highway departments, individually, through the American Association of State Highway Officials, and in cooperation with the Federal Public Roads Administration, are giving all possible assistance to urban highway officials in the solution of their traffic problems.

SMALL COMMUNITIES PLAN ALSO

Postwar highway planning is limited neither to particular regions nor to cities of any particular size group. It is widespread and has made much of the opportunity presented by the wartime lull in construction for the planning of more effective improvements for the future. Early in 1944, more than 380 cities of over 10,000 population had taken definite steps to provide postwar street and highway capital improvements, but more than half of the value of the projected outlay was confined to a relatively few large cities. In these large cities also, the greatest progress had been made in designs and specifications. However, it is said that some of the most complete and intelligent planning has been done by small communities.

From now on until the final victory, preparations for the postwar period will proceed at an accelerated pace in both large and small cities and in rural areas of both primary and secondary jurisdiction. In all this planning, one important change is paramount. All too often, planning has been done at the behest of visionaries or of bodies without authority to execute their will. Recently, planning has been made more practical, joined with the reality of financing, and committed to groups which are at the same time the planning bodies and the executing agencies. This compelling fact will be largely responsible for the postwar translation of blueprints into physical improvements of far-reaching social and economic significance.

IN LINE FOR WATER AT AN ADVANCED BASE IN THE PACIFIC

Water Supply on the Battlefront

Seabees Provide Potable Water for Combat Forces

By WILLIAM H. SMITH, M. AM. SOC. C.E.

CAPTAIN, CEC, U.S.N.; DIRECTOR, PLANNING AND DESIGN DEPARTMENT, BUREAU OF YARDS AND DOCKS, NAVY DEPARTMENT

DIFFICULT indeed it would be to decide which of the needs of a fighting man are most pressing. Certainly among the most urgent is water—good, thirst-satisfying water. The Seabees have, with typical ingenuity, devised all manner of supply and treatment methods. Not alone in this, they have worked with the Army, Marines, and other Navy branches on this problem, which is no respecter of branches of the service. This account by Captain Smith was presented before the Sanitary Engineering Division at the Annual Meeting of the Society in New York.

WATER is one of the essentials of life. Nowhere is this more surely known than on the battlefront. In military operations the provision of a safe supply of potable water is vital both to the fighting efficiency and to the health of the men engaged. In fact men can go much longer without food than without water.

This war, which extends over vast areas of the globe and into practically every kind of climate and terrain, has brought the Army, the Navy, and the Marine Corps face to face with many unusual and difficult problems, whose solution has taxed their ingenuity to the utmost. The problem of water supply has been no exception. That it has been solved, and solved successfully, is demonstrated by the extremely low incidence of water-borne diseases.

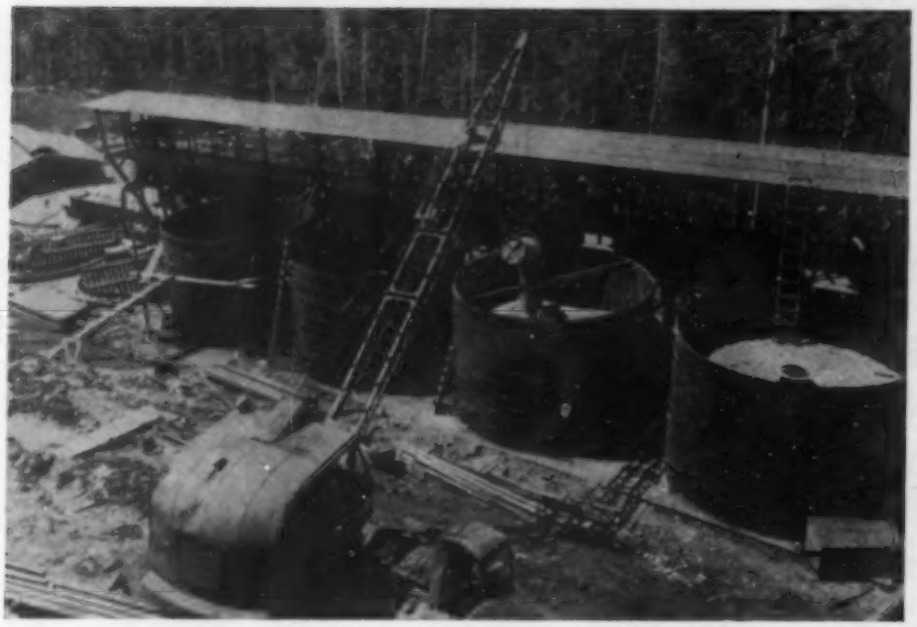
The problem of water supply on the battlefront is radically different from such a project in civil life. Instead of large permanent systems, frequently developed over long periods of years, constructed in the most durable manner possible and producing a water high in purity, clear in color, free of turbidity, and pleasant to the taste, in almost limitless quantities, to meet the exacting demands of a discriminating clientele, the problem on the battlefront is generally to supply a relatively limited quantity of safe potable water in an absolute minimum of time under the most adverse conditions, utilizing a minimum of standardized equipment and material to provide emergency installations which must generally be of the most mobile, portable, or temporary types.

Water supply depends on rainfall, climate, and terrain. We have been faced with the desert wastes of North Africa, the frigid barrens of the Aleutians, the steaming jungles of the tropics, the minute coral atolls of the Pacific Ocean, and almost every other conceivable natural condition. We have had to provide for everything from the emergency supply of one man separated from his command to major installations equivalent to those of a good-sized city.

Obviously no one solution has been found to the problem of water supply. Each locality becomes an individual problem requiring special adaptation of standard methods and equipment.

To solve it we have tried to take advantage of every resource which the engineering profession, the medical profession, and the manufacturer have had to offer. In the Navy, for example, the Civil Engineer Corps has included among its reserve officers many experts in water supply and sanitary engineering. In the Seabees, which are officered and commanded by the Civil Engineer Corps, are many specialists and trained men in these fields. The Medical Corps has also appointed many experts in its Hospital Corps for handling the special medical and bacteriological problems involved in insuring purity of water supply.

Since so many operations in this war have started as amphibious assaults, it is appropriate to describe the



FILTERS OF A LARGE TREATMENT PLANT IN THE PACIFIC THEATER

progressive steps taken to provide water in an assault of this type.

The first echelon of combat troops to be sent ashore takes with it cans of water from the landing craft. The jerry-can—a specially designed 5-gal can used for either gasoline or water—was a universal and omnipresent sight on the beachheads of Normandy. In addition these troops take with them special kits for chlorinating water from sources found available on shore.

Early in the invasion, Hospital Corpsmen in the Navy, and similar specialists in the Army and Marine Corps, are sent ashore to provide emergency supplies of sterilized water. Generally, the 35-gal Lyster bag is the equipment used. For disinfecting water in canteens, ampoules of chlor-dechlor are issued. These ampoules contain the chlorinating agent, and also a dechlorinating agent in a special wrapping which takes a certain time to dissolve, after the ampoule is broken into the water. The water is chlorinated during this interval and then dechlorinated as soon as the wrapping is dissolved, whereupon the water is ready to drink. In some cases it is common practice to treat small local supplies of water with iodine as an emergency disinfectant. For turbid water, a 4-lb hand kit is furnished which is capable of filtering 2 quarts of water per minute. This kit uses asbestos and wood pulp as a filtering medium. In a modified type, the filtering medium is surfaced with diatomaceous earth.

SUPPLIES DEVELOPED ON SHORE

As soon as the beachhead is secured, steps are taken to develop an adequate water supply and distribution system. Normally the type of supply to be secured has been planned in advance, based on information gathered from all available sources, covering the geology and water resources of the locality.

These water supplies may be from springs, from shallow dug or driven wells, from deeper bored or drilled wells, from rivers or ponds, from shallow infiltration tunnels, or from special catchment areas. There may be a number of small supplies, each serving a small force, or in the case of a relatively permanent major base, a large central supply system may be necessary, with complete clarifying, filtering, and chlorinating apparatus.

Where local water resources are completely lacking, as in arid regions or on small coral atolls, recourse is had to stills for securing a potable supply from sea water. In many cases these stills are used to supplement meager local supplies, which may be obtained either from shallow wells or even from roof runoff.

The amount of water furnished per man in the combat area will seem ridiculously small to municipal water supply engineers. It may vary from one gallon or less per man per day in actual assault operations to 15 or 20 gal per man per day at a well-developed semi-permanent base in rear areas. In rare cases does it approach the 100 gal per capita common in civil life.

Obviously, with such small issues, control of the use of potable water becomes of prime urgency. Treated water is usually restricted to drinking, cooking, and hospital use. Pit latrines eliminate requirements for flushing of sewage. Raw, brackish, or salt water is used for bathing and fire fighting. Laundering is also done with raw, brackish, or even salt water, except for the final rinsing. Spring faucets are utilized for the prevention of waste.

Where the supply is sufficient to provide fresh-water showers, the rule is "wet down, soap down, rinse." This is an old Navy custom aboard ship, and an army officer in the Pacific told me he was astonished at the number of men who could get a bath in this way out of 500 gal of water. It beats the British rule of "5 in. of water in the tub"! Incidentally shower enclosures in the tropics should be roofless, so the sun can get in and destroy the fungus that would otherwise develop.

SERVICES MERGED INTO ONE FIGHTING FORCE

Standardized equipment has been developed for many purposes in connection with battlefront water supplies. The Army, Navy, and Marine Corps have all contributed to this development, and many items are identical for all services. It must be emphasized that in this war the services are in fact merged into one fighting force, and elements of one service are used to support the others as circumstances may dictate, without regard to the uniform worn.

The Lyster bag is a canvas bag holding 35 gal of water, with small taps for drawing off the sterilized water. Sterilization is effected by dissolving an ampoule of calcium hypochlorite in a small quantity of water, stirring it into the raw water in the bag, testing with orthotolidine solution for the degree of chlorination, and repeating if no residual chlorine is indicated. The Lyster bag is also used as a dispensing unit, using pretreated water.

Portable water-purification units include pumping and treating units, coagulation and settling tanks, filtering units, chlorinating units, and various types of storage tanks. Some elements are omitted when the quality of the raw water permits. Storage tanks may be of canvas, wood stave, or steel. In many cases, Navy pontoons have been used for this purpose. The pumps may be air-lift, centrifugal, or rotary. Filters are either of the sand type, or more recently, of the diatomite type. Several

andard sizes and assemblies of ese units are stocked and issued.

SALT WATER DISTILLED

Distillation units are used where sufficient quantity of fresh water annot be obtained. Several dif- rent types and sizes of these units re available. Great improve- ents in the efficiency and econ- my of these plants have been ffected by the research and de- elopment carried on jointly by the ervices and the manufacturers.

The stills used early in the war ere two- and three-stage units sing both oil and gasoline for fuel. he newer stills are of the vapor- ompression type, using only one el. They produce a better and ifer distillate, at an economy, as easured in gallons of water per allon of fuel, from five to ten times s good as the earlier equipment. urther improvements are in proc- ss of development.

IN THE FROZEN NORTH A DAM IMPOUNDS A SUPPLY OF WATER

In this type of still, a gasoline engine operates a steam ompressor, and also drives the salt-water feed and dis- illate pumping units. Heat from the cooling and ex- haust systems of the engine is transferred to the incom- ng salt-water feed. No fuel is used for direct heating of he water. When the water in the evaporator reaches he boiling point, the compressor takes suction on the team produced and compresses it, returning the com- ressed steam to the evaporator chest. The work done y the compressor supplies additional heat to the system, aising the steam pressure and inducing further boiling f the salt water. The steam returned to the evaporator hest is condensed and withdrawn as distillate, while the oncentrated salt water overflows to waste continuously.

HYPO-CHLORINATION USED

Chlorination is usually necessary even after distilla- ion. These units may be either trailer or skid mounted. For large installations, a high-capacity automatic hypo-chlorination unit is provided which can either treat the entire flow with proper dosage, or a bypassed portion with concentrated dosage, to be remixed later with the untreated portion. Compressed chlorine gas is not used because of the shortage of bottles and difficulties of shipping and distribution.

LYSTER BAG, USED EVERYWHERE TO TREAT AND DISPENSE DRINKING WATER

Standard typical layouts have been prepared for complete schematic water supply systems, and standard assemblies are made up and furnished. Actual installations are adapted in the field to fit local conditions.

Occasionally at a major base a complete fixed installation comparable in all respects to a municipal system may be required. On battlefronts in civilized territory, as in Europe, for example, the existing municipal systems are rehabilitated, expanded, and improved as necessary to meet the Army's requirements. In other installations, dams have been constructed to provide adequate storage reservoirs on streams.

There are definite characteristics which all equipment must possess to be acceptable for battlefront and advance-base use. It must be rugged, efficient, light in weight, compact to minimize shipping space, reliable in operation, easily assembled and placed in service, and simple to operate. It must be able to stand the gaff of the severe combat-zone conditions without frequent breakdowns and need of repair. Above all it must be adaptable over a wide range of conditions, because it is imperative that the number of different types and models be standardized and reduced to a minimum, to simplify the equipment supply and repair problems. Spare parts for the multitudinous equipment and plant of this highly mechanized war is one of our most bothersome problems.

SKILLED PERSONNEL NECESSARY

No equipment, however satisfactory in itself, can do its work effectively unless it is handled by skilled personnel. Thus the training of the officers who supervise field operations and of the men who operate the equipment assumes major importance. In all the services, manuals of instruction in the assembly and operation of water supply equipment and in the principles and elements of water supply engineering on the battlefront have been prepared and distributed, and special courses of instruction are given at the training and indoctrination centers.

TREATMENT PLANTS

A brief description of one of the larger installations in the Pacific may be of interest. At this particular base an exceptionally large water supply was required to meet a heavy demand from ships, as well as to fulfill the base requirements. An ample raw water supply was

UNDER ENEMY EYES IT WAS NECESSARY TO CAMOUFLAGE THIS PURIFICATION PLANT

available from a nearby river. The water was turbid, had colloidal particles and organic matter in suspension, and contained B. coli. These conditions required aeration, coagulation, sedimentation, filtration, and chlorination.

The aeration tower was improvised with a welded pipe column and a pyramided series of wood trays, with layers of rock in each tray. The aerated water dropped from the lowest tray into a shallow sheet-metal tank, from which it was carried to the chemical mixing tank by a culvert made of steel drums.

The chemical mixing and sedimentation tank was a standard bolted steel tank. Chemicals were added as the water flowed into the top of a vertical wood pipe in the center of the tank and were mixed by engine-driven paddles located in this pipe. The water left the pipe near the bottom of the tank and rose past baffles, and over a weir to a circular trough at the top of the tank. From this trough the water was carried by a flume to six filters, containing beach sand over graded crushed rock supported on slats. The filtered water flowed into a flume where chlorine solution was added, and then into a clear-water tank. Low-lift pumps raised the treated water into steel storage tanks set on an elevation, whence the water was distributed by gravity. The project required several miles of heavy road construction through jungle and several miles of main piping. This entire system was constructed with materials and equipment on hand or locally available, and was built in less than 90 days, under adverse rainy-season conditions.

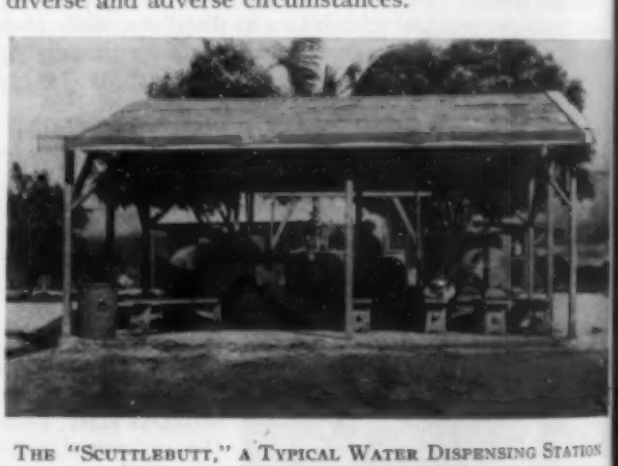
PROGRESSIVE DEVELOPMENT IN THE NORTH

In another northern island base, initial requirements were met by obtaining water from surface supplies, chlorinating with tablets, and dispensing by means of Lyster bags. Next, small combination pumps and hypochlorinators were set up, taking suction from surface waters and delivering chlorinated water into canvas tanks, from which it was pumped to the storage tanks of wood or canvas scattered at higher elevations through the camp areas.

Then ground-water sources were investigated, since it was known that the surface supplies would freeze solid and fail in the winter, and shallow wells were dug and proved. Pump houses were erected over the wells; gasoline-driven pumps installed and equipped with hypo-chlorite injection apparatus; wood stave storage tanks were erected at high points; and distribution lines were interconnected. Finally a dam was built in a gorge to provide adequate reservoir capacity at an elevation high enough to give good residual pressures throughout the area.

The provision of water on small atolls such as are encountered in the Central Pacific, presents an entirely different problem, best described by that old bit of poetry which runs "water, water everywhere and not a drop to drink!" Normally on such islands, there is a lens of fresh ground water floating on top of the salt water. It is frequently possible to tap this lens by shallow wells or infiltration galleries, provided the utmost care is taken to avoid lowering the water table more than a few inches so as to preclude salting. On low islands the center of the island affords the best potential source, while on land which is elevated, the most abundant wells have been developed along the shore. Because of the limited quantity that can be obtained, it is usually necessary to back up such systems with stills.

It is evident that there is no single, simple solution to the water supply problem on the battlefront. It has been necessary to provide simple, rugged, standardized equipment both for the initial emergency supplies and for the ultimate development of semipermanent systems. It has been the job of our Seabee commanders in the field and of their counterparts in the other services to improvise their water supply facilities from the available equipment, based on quick surveys of local resources, supplemented by advance data, and to build these facilities at the highest possible speed under the most diverse and adverse circumstances.



THE "SCUTTLEBUTT," A TYPICAL WATER DISPENSING STATION

The Civil Engineer Corps of the Navy and its new construction force, the Seabees; the Corps of Engineers and the Engineer troops of the Army; and the Marine Corps engineer forces have met this situation in such a way as to contribute materially to the combat efficiency of our armed forces. I would be remiss if I did not pay tribute to the part played by the sanitary engineering profession and by the manufacturers of the equipment used for their invaluable assistance in improving the standards of water supply and the reliability and efficiency of the equipment.

(The opinions and assertions expressed in this paper are the personal ones of the writer and do not necessarily represent the views of the Navy Department or the Naval service at large.)

Evaluating the Load-Carrying Capacities of Military Airfields

By GAYLE MCFADDEN, ASSOC. M. AM. SOC. C.E.
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FOR preparedness and our vast training program, it was of course necessary to convert many airfields to military uses, and to build many others under conditions of extreme haste. As a result, numerous questions as to their structural adequacy arose. To answer these questions, a comprehensive engineering survey of military airfields was initiated by the Corps of Engineers, as here explained by Mr. McFadden. He, with Reuben M. Haines, was author of the paper in the March issue which explained the design principles for airfield pavements developed by the U.S. Engineer Department.

MILITARY construction in this country for World War II was pointed toward beneficial occupancy of all installations with the minimum of delay. That part of the construction program relating to airfields was no exception. It was a "hurry-up job," and in many cases the progress chart took precedence over engineering judgment, calling for completion under conditions of weather and season which in peacetime most engineers would have considered insuperable.

As an example, a major military airport, constructed not too far from the nation's capital, covers an area of several thousand acres. It cost a good many million dollars, yet it had to be constructed in approximately eight months. It was built between October and May, during an usually severe and wet winter, entailing preparation of subgrade and base courses and the pouring of concrete pavements at temperatures as low as 15 F. However, this schedule was mandatory in order to provide facilities for pilot and operational training to meet war requirements. The deviation from peacetime principles of engineering and construction was obviously justified since our forces achieved and held air supremacy over our enemies.

These construction conditions obviously resulted in pavements having load-bearing capacities that were below those originally intended in the construction directives. It soon became apparent that this fact, together with the necessity for overloading the pavements to meet training conditions, would quickly distress them to the point of abnormal maintenance if not total destruction. The importance of correcting this condition was recognized both by the using service and by the constructing agency. Following a series of conferences between the Army Air Forces and the Office, Chief of Engineers, a program of "airfield pavement evaluation" was initiated by the latter office in the late summer of 1943.

The airfields to be evaluated were only those of military occupancy, and the survey was to determine the gross weight of airplanes that could use each field at capacity operation and at limited operation without overstressing the pavements. In view of the increasing weights of airplanes and the necessity for designating fields to be used by certain types of aircraft in the training program of the Army Air Forces, such a pavement evaluation was considered essential. The evaluation was to be based on the carrying capacities of the pavement as it was actually constructed, so that the Army Air Forces could determine the type of aircraft to be assigned to each particular field. A condensed sample of the data obtained is shown in Fig. 1. The significance of this will be more readily understood from what follows.

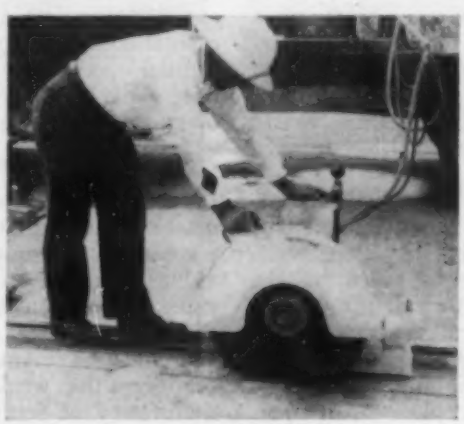
The general plan of evaluation was based on the principle that a chain is no stronger than its weakest link, the links in this case being the controlling pavements or sections of pavement. These controlling sections were specified as those subjected to normal use. Remote, obsolete, and little used pavements were not considered in establishing control. Thus a portion of a peripheral taxiway, or a runway of unfavorable location with respect to the wind rose, although the weakest pavement, will not be considered as a controlling pavement if it is used a relatively small percentage of the time. It was also determined that weak sections of pavement of limited extent need not control the overall evaluation of the field, since excessive maintenance or reconstruction of a limited area might prove more economical than to give a lower rating to the field as a whole.

In order that the data presented might have broad application and maximum use, the airfields were reported in terms of (1) field evaluation, based on the controlling pavement of the airfield as a whole, and (2) runway evaluation, based on the controlling pavement in the runway system. Definitions were established as follows:

Field evaluation is a statement of the gross plane weight, at capacity and limited operation (terms explained later), that may be operated at the field without excessive maintenance or reconstruction of any pavement. (In many cases, apron or taxiway pavements control this overall field evaluation.)

Runway evaluation gives the gross plane weight, similarly specified, that may be operated on any runway without excessive maintenance or reconstruction—except possibly at the end of runways. This evaluation is controlled by the runway with the least load-carrying capacity. (Note qualifications previously stated.) If the runway evaluation is greater than the field evaluation, and if planes specified for the runway evaluation are operated on the field, excessive maintenance or reconstruction of some pavements (other than runways) should be expected.

These criteria may not give the most economical field ratings but they appear to be the most practical, since



ELECTRICALLY DRIVEN SAW CUTS TEST SLAB FROM A PAVEMENT

PAVED AREAS				SUBGRADE		BASE				CONCRETE WORKING STRESS	SURFACE			GROSS PLANE WEIGHT		PRESENT CONDITION	CONSTRUCTING AGENCY
Identification (1)	Length Feet (2)	Width Feet (3)	Area Sq Yds (4)	Classification Casagrande (5)	"CBR" or "K" (6)	Type (7)	Thickness Inches (8)	"CBR" or "K" (9)	When Built (10)	(11)	Type (12)	Thickness Inches (13)	When Built (14)	Capacity (15)	Limited (16)	(17)	(18)
E–W Runway Sta. 0-00-50-00	8000	200	111100	Silty Sand SF	15	Crushed Stone	7	80+	1941		Asphaltic Concrete	3	1941	35000 (3)	60000 (3)	Very Good	W.P.A.
NW-SE. Perimeter Taxiway	4100	50	22800	Silty Sand SF	15	Crushed Stone	8	80+	1942		Asphaltic Concrete	3	1942	37000	80000	Surface Uneven	U.S.E.D.
Apron and Connecting Taxiway			38500	CL and ML		Pit Run Sand and Gravel	6	160	1941	248 (1) 321 (2)	Concrete 8"-6"-8"	6	1941	20000 (4)	38000 (4)	Some Transverse Cracks, Few Corner Cracks	U.S.E.D.
Apron Widening			20000	CL and ML		Pit Run Sand and Gravel	6	160	1944	328 (1) 411 (2)	Concrete $10\frac{1}{2}$"-7"-$10\frac{1}{2}$"	7	1944	45000	75000	Very Good	U.S.E.D.

NOTES

(1) Working Stress – Capacity Operation
(2) Working Stress – Limited Operation
(3) Controlling Pavement – Runway Evaluation
(4) Controlling Pavement – Field Evaluation

TRAFFIC DISTRIBUTION

NW–SE 50%
NE–SW 35%
E–W 15%

GENERAL

Maintenance Will Soon Be Necessary to Level the Surface.
Flexural Strength for Each Concrete Section Determined from 8 Beam Tests on Pavement Removed.
Service Record of Coarse Aggregate Indicates that Excessive Maintenance, Due to Conditions Other Than Traffic, May Be Expected After a Ten Year Period.

TRAFFIC HISTORY

This Field Has Been Used Regularly. The Only Available Traffic Records Are for the Period June 1943 to September 1944 During Which the Landings and Takeoffs (1 Cycle) Averaged 450 Cycles per Day of B-24's with a Few Cycles of Transient Pursuit Ships.

FIG. 1. TYPICAL DATA SHEET AND HISTORICAL RECORD FOR AIRFIELD PAVEMENT EVALUATION PROGRAM

it would be impossible to give an evaluation which would anticipate an indefinite degree of maintenance and at the same time permit assignment of airplanes of definite weights to the station.

Repetition of load is a factor in the design of both rigid and flexible-type pavements, and therefore a factor to be considered in evaluation. This factor is reflected in the definitions of field and runway evaluation by the terms "capacity operation" and "limited operation." Because of the extremely large training program, it soon became obvious that a clear definition should be established for these terms, to assist the Army Air Forces in interpreting the results of the survey. The definitions established are as follows:

Capacity operation is defined as the maximum traffic that can possibly operate on an airfield for a period of approximately 20 years. Daily operation may be assumed to vary from 100 for the very heavy planes, to 1,500 for very light planes.

Limited operation is defined as a few operations a day for a period of approximately 20 years (about 10% of "capacity operation"), or as the maximum traffic that can possibly operate for a period of 2 to 4 years. However, a pavement used by the maximum traffic that can possibly operate for a period of 2 to 4 years under the limited-operation rating, may require greater yearly maintenance than another pavement used in accordance with the capacity-operation rating.

Many airfields will not be subjected to capacity operation within the intent of the preceding definitions. Therefore, in order to obtain maximum use of all available fields for training, consideration is given by the Army Air Forces to the expected traffic and the desired life of the installation in making aircraft assignments.

Note that this evaluation procedure does not preclude the occasional landing of a plane weighing in excess of the limited-operation rating. Heavy planes can operate for a short time or for a few repetitions, on pavements evaluated for much lighter loads but this does not mean that such pavements are adequate or will be satisfactory for capacity or limited operation by planes of such weight. As an example of the evaluation procedure, consider the case of a field evaluated as follows:

	CAPACITY OPERATION	LIMITED OPERATION
Field evaluation	13,000 lb	25,000 lb
Runway evaluation	40,000 lb	62,000 lb

It can readily be seen that there is a wide spread between the 13,000 lb designated for field evaluation at capacity operation and the 62,000 lb designated for runway evaluation at limited operation.

In this case the 13,000-lb load for capacity operation, which controls the overall field evaluation, might well be the load determined for an important taxiway between a principal runway and the apron. If, because of the application of excessive loads, the taxiway became unusable or destroyed, or even in need of major repairs, the value of the field would be impaired by reason of the inaccessibility of the service and hangar area to the flight area. This pavement, in all probability, also controls the limited-operation value placed on the entire airfield, and indicates that it may be used for aircraft heavier than 13,000 lb within the limitations established in the definition for limited operation.

Although the pavement sections that control the field evaluation are important and essential links in the overall system, they may happen to be comparatively small in area. Hence, in order not to exclude the field from its potential use by heavier aircraft and thereby vitiate the investment, the runway evaluation is shown to point out the maximum availability of the field. In this case the capacity-operation value of 40,000 lb and the limited-operation value of 62,000 lb are predicated, not necessarily on the weakest runway, but on the weakest one normally in use.

MAP AND REPORT IN FULL

Included in the evaluation survey report is a layout map showing all runways, taxiways, aprons, and other pavements, accompanied by a legend to indicate the values assigned to the various pavements. Thus, the using service, having full knowledge of the capabilities of the pavements, may elect any one use or a combination of uses. Among the possibilities will be (1) to reinforce the weak controlling pavements to provide uniformity of service, (2) to station aircraft commensurate with the capacity overall field evaluation in the expectation of prolonging the life of the field, (3) to station aircraft of the weights indicated by limited operation with knowledge of the shortened life and excessive maintenance that would result if used to capacity, (4) to station heavier aircraft than recommended by the survey while adopting a program of abnormal maintenance and possible reconstruction, and (5) to permit the occasional landing of heavier aircraft within reasonable limits.

The Airfield Pavement Evaluation Report is a careful compilation of data reflecting the as-built condition of

e pavements. It includes such items as (1) description the field; (2) construction history, including construcon weather conditions; (3) description of the pavement sign; (4) extent of investigations, both field and labotory; (5) condition of the pavement at the time of the rvey; (6) history of pavement service and maintenance; (7) traffic history; and (8) results of investigaons. Accompanying it are appendices which include) a historical and data summary sheet (Fig. 1) which ows each unit of pavement, together with the length, idth, area, subgrade, and base-course classification and lue, type, and thickness of the surface and date built, d the condition of the pavement; (2) a plan of the airld, summarizing the carrying capacity of the pavents; (3) a description of the field and laboratory testg procedures; and (4) a key map with test-site locations.

Principles of the evaluation are essentially the same as ose established for design in the *Engineering Manual* of e Office, Chief of Engineers, U.S. Army, and discussed General Stratton in his paper, "Military Airfields—Construction and Design Problems" (PROCEEDINGS, Am. c. C.E., January 1944), except that they are applied in verse order. Instead of making tests of foundations d construction materials to determine the expected sults for design requirements, the evaluation survey sts the in-place values of the pavement constituents, d these values are applied to design formulas to deterine the carrying capacities of the pavements.

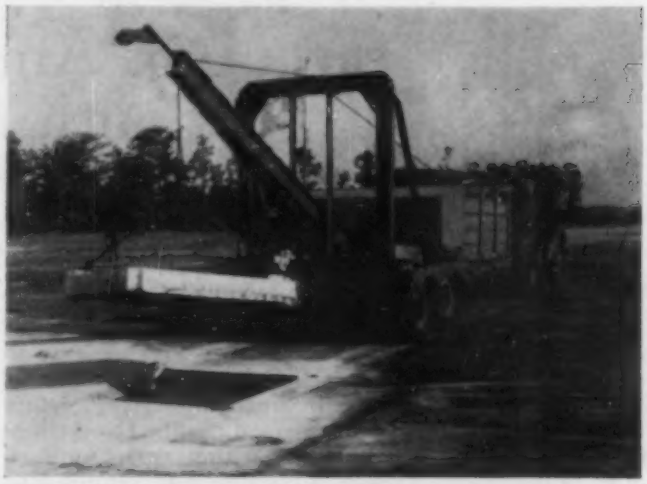
SOME TEST PROCEDURES

For flexible pavements, the California Bearing Ratio .B.R.) method is employed, as discussed in a compann paper ("Design of Airfield Pavements Developed U.S. Engineer Department," by Gayle McFadden d Reuben M. Haines, CIVIL ENGINEERING for March 45). The C.B.R. of the subgrade and base is deterined by the in-place method if the material is at or near turation and if further compaction is not anticipated, in the case of most cohesive soils. If favorable moisre and density conditions, which are dependent on soil

PLATE BEARING TEST ASSEMBLY IN OPERATION

pes, do not prevail, undisturbed or remolded samples e employed in accordance with the provisions of the gineering *Manual* previously referred to. It should be ted, however, that while the California method is exected to insure design to prevent shear deformation in e base and subgrade, it is not expected to insure against vement settlement due to compaction of the underlyg soils by traffic.

For rigid pavements, portions of the pavement are moved, and the modulus of soil reaction for a saturated ndition beneath the pavement is determined by field ate-bearing tests. Beam samples of the pavement are ken and the actual flexural strength determined. Since



DERRICK OF PLATE BEARING RIG LIFTS A TEST SLAB

the design factor for concrete paving slabs, established by the U.S. Engineer Department, is based in part on flexural strength at 28 days, the flexural strength at the time of evaluation is adjusted to account for the increase that should have developed after the 28-day period, unless conditions are present which indicate the advisability of using a lower value. The design factors in the *Engineering Manual* are for usual conditions.

Results of the in-place investigations are applied to the design formulas as published in Chapter XX of the *Engineering Manual* and illustrated in General Stratton's paper, to assign the load-bearing capacities of the pavements as built. Consideration is given to possible frost action in connection with the evaluation of both flexible and rigid pavements, and where justified the load-carrying capacity is correspondingly reduced.

Many factors which cannot be allowed for in the design influence the condition of the completed pavement, such as variation of materials, unpredictable weather conditions, and variable construction control. Other changes may occur subsequent to or during construction, such as unforeseen changes in the moisture content of the subgrade and base, an increase in compaction under construction or operating traffic, or a decrease from the specified compaction. Hence it is believed that the general principles employed in the evaluation survey produced valid results.

WIDE APPLICABILITY SEEN

All investigations were conducted under a uniform procedure established and published by the Office, Chief of Engineers. This was because results had to be obtained that could be evaluated without regard to jurisdictional lines, since the surveys were conducted by about fifty Engineer Districts comprising about nine Engineer Divisions.

Apart from its immediate purpose, as here stated, the evaluation survey will be of inestimable value, it is believed. The report contains historical data, descriptions and analyses of pavement structure, and other pertinent items that will be of great assistance to operating and maintenance personnel. If weak or doubtful sections are known in advance, precautions can be taken to minimize maintenance costs and to initiate reconstruction or reinforcement to preserve the maximum salvage value of existing structures.

Since the airfields evaluated are under military occupancy, the results of the survey cannot be published and distributed at this time for reasons of security.

The Future of American Engineers in South America

Presented Before Sanitary Engineering Division at Society's Annual Meeting in New York

By JOHN P. HOGAN, PAST-PRESIDENT AM. SOC. C.E.
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IT is difficult to generalize about a continent—whether it be Europe, Asia, or South America—because the character of the peoples and their degree of development differs as widely as their climate and resources. With the exception of Argentina, the intensive development of South America is in general confined to the seaboard, and to areas averaging within three hundred miles of it. Most of the discovered mineral resources lie within this area. The remainder of the continent is generally developed only for agriculture and cattle raising, or remains undeveloped. Interior agricultural developments have been retarded by lack of transportation. The present population of the entire continent is variously estimated at between 75,000,000 and 90,000,000, or about 12 per sq mile, as compared to a density in the United States of 45 per sq mile. Considering its agricultural resources alone, it has been estimated that the continent would readily support a population of over three times the present one if adequate distribution facilities were available.

In our modern civilization, however, it would be impossible for a purely agrarian civilization to reach a high standard of living without a corresponding industrial development. The South American continent is the poorest of all the continents in mineralogical resources, just as the North American continent is probably the richest. The absence of a carboniferous age in the greater part of the continent prevented the formation of coal, and such deposits in all of South America are relatively insignificant. In the northern part, principally in Venezuela and Colombia, there are large deposits of oil, which are at present good producers, although they have not as yet been entirely explored. There have also been some indications of oil deposits along the eastern slope of the Andes, although their location and extent are as yet unknown.

The main mineralogical resources so far developed are along the western slope of the Andes, where there are considerable deposits of iron and copper, and along the northern and eastern shores. In British and Dutch Guiana are located the largest deposits of rich bauxite ore, and these have been extensively developed by British and American interests. In eastern Venezuela, both gold and iron are found in considerable quantities, and in the Province of Minas Geraes in Brazil there are vast quantities of iron and mangesite, and indications of numerous other commercial metals which have not yet been adequately explored or developed. There are also large quantities of crystals and other semi-precious stones and even extensive deposits of precious stones, including black and white diamonds.

The absence of a suitable grade of coal has largely prevented the development of smelting and refining industries, and the principal exports to date have been bulk ore. While gold of the placer type is abundant in many localities, no mother lodes have been discovered, except in certain portions of the western coast, and in eastern Venezuela.

The general immediate outlook for the continent as a whole is confined to industries for the production of consumer goods, and for the export of raw materials, with a growing tendency toward the production of capital goods for local use only. Even in the most fertile parts of the country and those with the best climate, there are frequent shortages in food supply, due to poor distribution of the population and lack of transportation.

South America as a whole has two very great advantages. The most important of these is the penetration of the entire country by a marvelous system of rivers which, with slight improvement, would afford excellent transportation to a large part of the interior, and even at present permit penetration to the remotest parts of the continent. The second great advantage is that the topographical characteristics of the country afford opportunity for the development of an almost unlimited supply of cheap water power, which in a measure compensates for the lack of coal. Utilization and development of these two great resources has to date been handicapped by lack of capital. Too much of the capital available for South America has been expended in the development and adornment of the large cities and for easy ways of living, and too little in the development of the natural resources and improvements in the general standard of living.

While many of the cities are older than any in the United States and have a highly developed culture, the development of a large part of the South American continent is about in the stage which prevailed in the United States shortly after the Civil War. The length of the existing railways at present is somewhat less in proportion to the population than that in the United States at that time. We proceeded immediately after the Civil War to develop our mineral resources and to promote

ORE DOCK AT VICTORIA, BRAZIL, IN COURSE OF CONSTRUCTION
This Large Project Is Terminus of Railroad from Rio Doce Valley

EXCAVATION FOR A RAILROAD CUT IN SOUTH AMERICA
Where Labor Is Plentiful, This Is One of the Usual Methods of Earth Moving in This Section of Brazil

HAND EXCAVATING FOR BRAZILIAN RAILROAD CUT
After Narrow Slots Are Dug by Hand, Mass Is Toppled Over and Disintegrates on Falling

...nse industrialization. Since the necessary population did ...t exist in this country, we resorted to the importation ... millions of immigrants.

It is apparent that the development of South America ...ust be carried on at a much slower rate and must take a ...mewhat different course from that of the North ...merican continent. This is particularly true since the ...chnique of transportation has changed greatly. In ...r development, railroads were used largely for pro...otional purposes, and thousands of miles of rails have ...nce been torn up because they could not be operated ...ofitably. It would seem that in the immediate future ...e development of South America should proceed along ...e lines of improvement of water transport and feeder ...ads, and that railways should follow later, when there ... sufficient traffic to warrant their construction. Com...rtable access to remote places which formerly could be ...btained only by means of railroads, can now be assured ... a fraction of the time by a comprehensive network of ...rways.

We hear a lot today about the Pan-American Highway ...d various ramifications of it. What South America ...ally needs is all-weather roads from centers of produc...on to centers of consumption, export, or import. Very ...tle thought is being given to this, and in a great many ...aces money spent for spectacular projects could be ...uch more usefully employed in local roads. South America is literally alive with railroad projects, but sight is often lost of the fact that a good road is a much better and more economical means of transportation than a poor railroad!

Engineering judgment in the development of South America has been largely guided during the past few years by missions of specialists, who concentrate on their specialty and attempt to prescribe standards which are generally unsuited to the continent and its present state of development. This tends toward the creation of isolated spots or oases of American standards, while the interests of the continent as a whole would demand that the available capital be more evenly distributed for the general benefit. I have dwelt on this at greater length than I intended on account of the necessity of giving the general picture of the existing situation before attempting to enter into the possibilities for the future.

Opportunities for the sanitary engineer in South America are unlimited, and sanitation probably represents the most highly developed branch of the engineering profession in South America. Both American and other foreign engineers contributed to the growth and development of the scientific and practical side of this branch of the profession. Sanitation developments, however, for the past fifteen years have not kept pace with the demand on account of lack of the necessary capital and of the necessary materials. The necessity for expediting the sanitation program immediately after the close of the present war is thoroughly understood by South American engineers.

In general, they have the necessary technical knowledge to do this work, but the trained forces available are entirely inadequate for a "stepped-up" program either in the field of design or in that of construction. The present prevalence of water-borne and insect-borne diseases is not due to lack of knowledge on the part of South American engineers, but to the lack of funds and forces to carry out the necessary improvements. There should be, therefore, on the entire continent after the war, a tremendous increase in the construction, expansion, and perfection of the existing water supplies and sewer systems. In particular, there is much work to be done in preventing pollution of existing systems.

CONTRACTOR'S CAMP ON SOUTH AMERICAN RAILROAD JOB
Temporary Laborers' Quarters Have Reinforced Clay Walls and Thatched Roofs

ROCK EXCAVATION IN SIDE CUT IS HAND DRILLED
Wooden Poles Are Used for Scaffolding in Brazilian Work

A great missionary work has been done by the Division of Health and Sanitation of the Office of the Coordinator of Inter-American Affairs, which has helped to awaken the conscience of the South American people to the necessity for improved sanitation. All realize that development is very considerably dependent upon the awakening of public sentiment to the unnecessary waste caused by water-borne diseases. Assistance in the development of adequate water supplies would appear to be the first task of American sanitary engineers, together with the development of distribution systems, which also have been neglected and are generally inadequate. This must of course go hand in hand with adequate sewerage development.

Following these in importance would appear to be the removal of the blight which rests on large portions of South America due to insect-borne diseases, of which the most prevalent is of course malaria. We are apt to forget that one hundred years ago malaria, known as "aches and chills" was prevalent in the entire Ohio and Mississippi Valley country, where few if any of the inhabitants were immune. We do know, however, how few precautions are necessary to secure immunity from insect-borne diseases. These do not call for any works of magnitude. Every American sanitary engineer who goes to South America, however, should make it his business to help formulate public opinion. Here again we find that by force of example the engineers of the Health and Sanitation Division have made a great beginning in helping to educate the public.

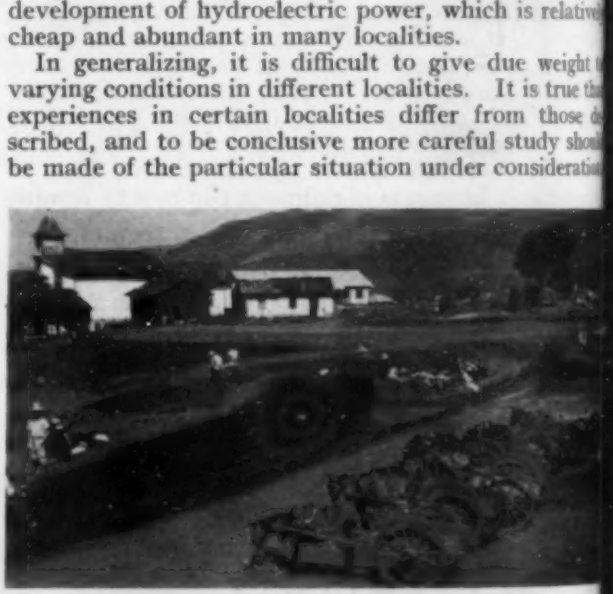
Except for a relatively small number of the larger cities, and there only in exceptional cases, the state of development of the South American continent has not reached a point that requires extensive sewage disposal works. We all know very well that sewage disposal should go hand in hand with water supply. Theoretically, all effluent from sewage should be purified. Furthermore, we know that the cost of sewers and all sewage purification should be a part of the charge for water, and yet we, even in this country, are still relying on dilution except where conditions become dangerous or disagreeable. Our failure to succeed in selling these ideas in the United States gi little prospect of our being able to sell them at the pres time in South America which, like all growing countri has a greater demand for capital than can be supplie There are, however, places in South America where co centration of sewage has already developed into nuisance, but these are relatively few.

It is therefore my firm opinion that the greatest imm diate opportunities for American engineers in Sou America after the war will be in water supply and di tribution, and in sewerage development. Next to th I would place port and river developments and roads, a by this I mean all-weather local roads rather than int regional highways. Next in order of importance will the reconstruction and rehabilitation of existing railw and the construction of new railways where they a warranted by existing or prospective traffic.

Paramount to all this, however, will of course co the assistance which American engineers can give South America in industrial development. This w involve not only the design and equipment of loc factories but also the development of branch establis ments either for manufacture or assembly of America type products for the local market. There is no prese local capacity for the production of tools and machine for manufacture, and everything must come from abroa American machinery is generally preferred on accou of superior performance, but too frequently in the pa foreign machinery has been preferred because of low cost, better salesmanship, or longer credits.

From a long-range point of view, and as a result of th absence of local coal deposits, the future economic de velopment of South America will be dependent on th development of hydroelectric power, which is relativel cheap and abundant in many localities.

In generalizing, it is difficult to give due weight t varying conditions in different localities. It is true tha experiences in certain localities differ from those de scribed, and to be conclusive more careful study shou be made of the particular situation under consideratio



RAILROAD YARD AT CAMPESTRE IN BRAZILIAN MOUNTAINS
Time Out for Servicing Equipment

To those used to American business methods, Sout America is often a lesson in patience. The countri and communities are less highly organized than we ar and have much less in the way of precedent to go o There are more people to be consulted and it takes the longer to make up their minds. Unfortunately, in many localities, slowness in decision or want of decision als handicaps the execution of the work. However, Ameri can engineers must accept these conditions and subscrib to the varying regulations prescribed by varying loca laws if they want to make progress.

Airfields "Custom Built" by Aviation Engineers

By GEORGE MAYO

COLONEL, U.S. ARMY AIR FORCES; AIR ENGINEER, WASHINGTON, D.C.

A CORAL landing strip on a Pacific atoll or a permanent airfield in Britain—it makes no difference to the Aviation Engineers. The work goes forward with dispatch, adapting methods and materials to the needs of the Air Force. Unusual conditions encountered and the aggressive ingenuity of the Engineer aviation battalions in all theaters of operation are the subject of this paper by Colonel Mayo. It is adapted from an address he gave before the District of Columbia Section of the Society.

LONG before Pearl Harbor, our growing Air Force indicated a vital need for engineers specialized in the building of airfields. The grass plots which had been adequate for the planes of World War I had to be replaced by extensive tracts of land cleared of obstacles and provided with all-weather runways capable of handling the superbombers of World War II. To build such airfields the Air Forces needed their own engineers, troops who were trained with it intimately, who spoke its language and who understood its needs. These men—now known as Aviation Engineers and totaling over 100,000 officers and men—were trained to construct airdromes, to improve and maintain the facilities of existing dromes, and to defend such installations when necessary. They were trained in camouflage of airfields and the construction of defensive works and were organized into units fitted to the varied tasks to be accomplished. These units—the first of which was organized in June 1940—now total 340 and include the standard battalions, air-borne battalions, camouflage and utilities units.

Air Force commanders now recognize that a great part of the success of air operations, dependent as they are upon advance airfields, is due to the thorough equipping of the Aviation Engineers. To illustrate the difference between our operations and those of our enemy, our engineers built the fighter strip at "Big Mike" on Attu within nine days from the time the bulldozers landed. By contrast, the Japanese never finished their poorly chosen landing fields at Kiska and Attu. They lack the necessary equipment to do a quick and adequate job.

The standard battalions, which far outnumber the other engineer aviation units, are equipped with a large variety of heavy-duty airfield construction machinery. The smaller, air-borne battalion is equipped with very light airfield equipment, designed primarily to be carried in the C-47 transport plane or in the CG-4A glider. These units land under combat conditions in almost any open area to unload their equipment and to build a strip capable of taking transport planes at the earliest possible time. The heaviest piece of equipment carried by the air-borne units weighs 4,230 lb. The baby equipment is used initially to prepare the first strip.

A great advance has been made in the art of breaking down the heavier equipment, into loads capable of being carried in C-47, C-46 and C-54A transport planes and the CG-4A glider. Practically every item of heavy equipment we now have, up to and including the D-8 bulldozer, has been broken down for transport by air. In some cases disassembly is accomplished by cutting with a torch and welding on plates which are bolted together upon reassembling. It is difficult to conceive, but is nevertheless a fact, that the 25-cu yd per hr rock crusher can be transported by air to a forward area and set up for operation in a matter of a few hours.

RUNWAY DESIGN

Main features of a runway are its length, width, direction, and load-bearing characteristics. Initially, there is usually only a single runway, located as nearly in the direction of the prevailing wind as the topography will permit. The length will depend upon the type of plane and its take-off characteristics, and may be seriously affected by the current practice of overloading the planes. Fighters and transports can get along with as little as 4,000 ft; medium bombers require 5,000 ft; heavy bombers, a minimum of 5,000 ft up to 6,000, and very heavy bombers normally in excess of 7,000 ft. The present empirical practice is to add 10% to these lengths of the runway for each thousand feet of elevation.

Excessive changes in temperature, however, may have a more serious effect than has the elevation. This is because of a sharp lessening of the density of the air. Up drafts may help or hinder. On one occasion a pilot, who was taking me onto a field on an island off Panama in a little cub plane, took four passes at the field before we could get down. It was a strange sensation to have an

MEN AND EQUIPMENT ARRIVE AT A NEW FIELD BY GLIDER

'LIVE" CORAL FROM A PACIFIC BEACH PROVIDES AN EXCELLENT BASE FOR AN AIR STRIP

GRADING A CORAL RUNWAY AT AN ADVANCE FIELD

airplane in a glide angle, the engine throttled down, and yet see the needle on the altimeter rising.

For fields in this country or in the rear areas of a theater of operations, the most serious consideration is the gross weight of heavy bombers. As the demand for more and more range keeps pace with the changed conception from continental air warfare to that pertaining to the entire globe, the problem of gross load becomes greater and greater. Bearing in mind the rough rule that for every one thousand miles of increase in range, the necessary fuel load doubles the gross weight, it can be seen how serious the problem may become—not so serious here in this country where equipment, labor, and materials are readily available, but very serious in a theater where all labor, plant, and materials may have to be imported.

The commercial plane that we see in greatest numbers is the DC-3. It weighs approximately 25,000 lb. Our heavy bombers weigh approximately 65,000 lb, our very heavy bombers, such as have lately been bombing Japan weigh, fully loaded, about twice that figure. Even larger planes are under development. The B-29 utilizes a tricycle landing gear with the greater part of the load carried on two dual main wheels. The dual wheels help very much in distributing pressure. As we get into the realm of planes heavier than this, however, we find that the plane designers feel that they must sacrifice everything to gain the desired range. Therefore, tricycle gears with single main wheels are contemplated. Under these conditions, on soils having an average bea capacity, a base course of 48 to 60 in. may be requir The inability to provide widespread facilities of th magnitude may require the design of aircraft with dua triple, or quadruple landing wheels—or even tractor-ty landing gear. Structural problems in airplane des may govern this. In the meantime, tests are under w at Hamilton Field, California, and Lockbourne Arm Airfield, Ohio. A photograph shows the vehicle used applying gross loads up to 200,000 lb. The wheel siz and spacing approximate those of the B-29.

FIELD CONDITIONS

Soil investigations and tests in connection with th construction of airfields in overseas theaters have been necessity very limited in character. The extent an type of the investigations are dependent on the conditio predominant in each region. For example, in th Aleutians no tests were necessary to indicate that tu dra—which was soft and spongy—should be remove to reach firm foundation. The fills were generally sand or sand and gravel, so there was no question as t the stability of the fill material. Landing mat was use as a wearing surface.

In the Central and South Pacific, a majority of th fields were constructed on coral foundations, which wer exposed when the weathered topsoil was removed. These foundations were excellent and, in general, re quired about one foot of compacted coral base. Th soil investigation consisted of finding "live" coral for th base course, which would cement when wet and rolled.

CHINA-BURMA-INDIA

In the China and Burma-India theaters, where condi tions are less desirable for the construction of runway bases, compaction tests, and particularly tests to deter mine changes in the volume of the soil, or shrinkage, are important. A simple expedient has been devised in that theater for using coffee-extract cans, found in "C" rations, as containers for making shrinkage tests of binde soils. Additional compaction cylinders, to supplement the standard equipment of the soil-testing set used i controlling density of fills, have been improvised from brass 90-mm shell cases and airplane shock-absorber parts.

RUNWAY CONSTRUCTION

In constructing a temporary runway, taxiway, or hard standing in a theater of operations, there are three im portant elements—drainage, stabilization, and surfacing Drainage must always be provided for even in the mos arid country, not only to provide for occasional rain but also for capillary action. Subgrades softened by contained water will cause a quick breakdown. In the Galapagos Islands, the rainy season is one week long in February. As much as 5 in. may fall in this week.

Airfields constructed in the theaters of operations are necessarily reduced to the least common denominator With the exception of limited surfacing material, the materials for construction are those found on the site and those only. If the subsoil is of the ideal type, all that is needed in the way of stabilization is compaction both with sheepsfoot and wobble-wheel rollers. Otherwise added material such as gravel or sand may be re quired. As to surfaces, concrete slabs are too deliberate for combat airfields, and asphalt is normally not avail able. The answer appears to be some sort of a portable surface, easily transported, which can be quickly laid. The best all-purpose surface developed so far is the porta able landing mat of steel pierced plank. This weighs

proximately 5 lb per sq ft, and can be so laid that a gle plank may be removed from the center of a runway thout starting from the edge and working inward. eel pierced plank can be laid day or night under stress combat conditions at an average rate of 125 sq ft per n-hour.

A newer all-purpose surface, and when I say "all-rpose" I mean one capable of taking up to and includ- the very heavy bomber with a properly prepared sub- se, is the aluminum portable landing mat of the pierced nk type. Aluminum plank is equal in strength to el, weighs just about one-half, but costs four times as ch. Formerly it was necessary to insert spring clips prevent the steel planks from sliding and disengaging ir connectors. However, an integral lug, which auto- tically locks the connectors, has been invented so re is no longer a need for clips. Because of the de- ased weight, the aluminum mat is particularly adapted airborne purposes and it has been found that it can be d by unskilled labor at the rate of 250 or more sq ft r man-hour.

PREFABRICATED BITUMINOUS SURFACING

A development that has come out of the Normandy fields is a surfacing of asphalt-impregnated jute or bur- fabric, commonly known as prefabricated bituminous facing, or "PBS." It is smooth on both faces and has a ck glazed appearance similar to an asphalt pavement. BS is distributed in rolls containing a strip about 3 ft de and 100 yd long, the rolls averaging 350 lb in weight. his surfacing material is primarily a waterproofing ent. It is laid by a machine called a "stamp-licker" ich applies a solvent to the under side of the strip using it to bond when laid with a 50% overlap. Use a 50% overlap results in a double thickness of PBS er the entire runway.

The principle involved in this development is based on e fact that most soils have adequate bearing capacity d will support any service load provided the soil is mpacted and maintained in a reasonably dry state. has been found in France that this material, carefully d on a compacted subgrade, makes a satisfactory run- ay surfacing for almost any type of fighter, fighter- mber, or transport. At the take-off or warm-up end the runway, it is usually necessary to overlay the PBS th steel-mesh grid or portable steel plank, because of e tearing action which results when planes make locked- heel turns. For heavy bombers, it is usually necessary lay portable steel mat for hardstands and aprons.

Another interesting development that came with the vasion of France is the use of ordinary welded mesh,

FACES ARE TESTED FOR LOADS UP TO 200,000 LB WITH LOADED TRAILER

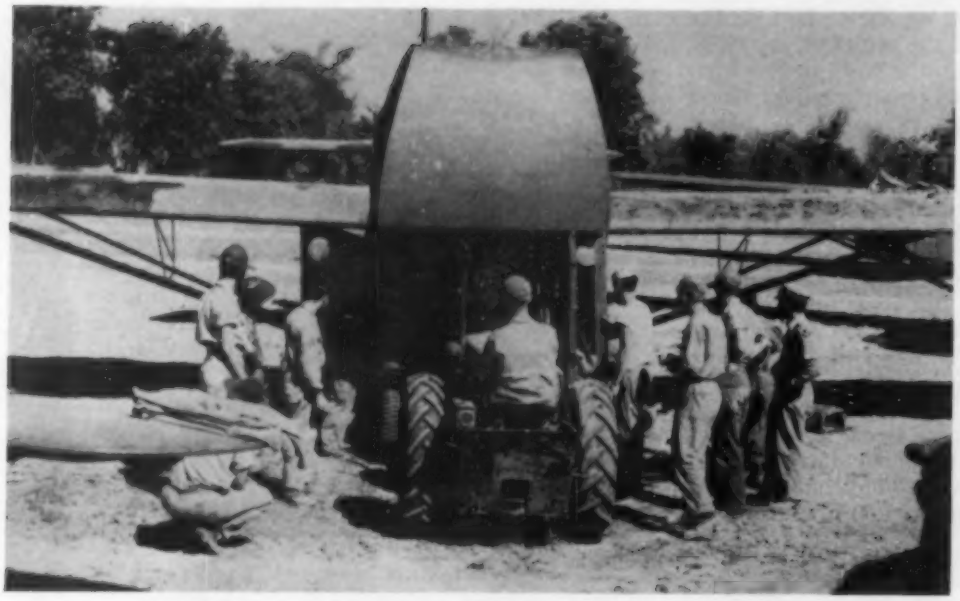
WELDED STEEL MESH IN USE IN FRANCE

PREFABRICATED BITUMINOUS SURFACING APPLIED TO A FIELD IN FRANCE WITH A "STAMP-LICKER"

similar to that used for concrete reinforcement in high- way work. In the early days prior to the development of portable steel plank, a steel mesh was tried out in this country and rejected primarily because of the difficulty of finding a suitable connector. The early mesh surfacing was a series of rectangular sections joined together by a large type of Bostitch connector. In France the prac- tice is to lay the welded mesh from rolls, and connect it up with a heavy connector. Steel mesh is not quite so uni- versally used as the prefabricated bituminous surfacing.

"I'LL TAKE CARE OF THE WEATHER"

The employment of Aviation Engineers in the North Africa-Sicily-Italy campaign was as near perfect as that anywhere in this war. The Aviation Engineer battalions were grouped in a single Engineer Command under the late Brig. Gen. Donald A. Davison. One of the main difficulties to be overcome was the topography. In one case the only area level enough to permit construction of an airfield was at the mouth of the Cebouse River, where the subsoil consisted of approximately 18 ft of muck. It could not be compacted; the only answer appeared to be a blanket of sand. The nearest sand lay across the river, which was subject to rapid rises. The answer appeared to be the construction of a sand bridge across



A GLIDER LOAD OF TRACTOR AND GRADER WILL SOON START FOR A NEW JOB IN THE ENEMY'S FRONT YARD

the river and the transport of some 66,000 cu yd of sand by carryall and dozer to the runway location to form a sand blanket in excess of 2 ft thick. The rainy season was at hand. They were all worried that even a slight rain might cause a rise, wash out the sand bridge, and so prevent the building of the field. General Davison, as fine a man as has ever existed in this Army, and deeply religious, said, "I'll take care of the weather," and he did. On the last day of the deadline, with the sand blanket laid and fine-graded and the last planks of portable steel landing mat going into place, the heavens opened up and a deluge came down, but the airfield was built.

One other element of the situation in North Africa was the desirability of constructing one or more decoy fields in connection with each regular field. This was easy, as most of the fields were unsurfaced, and the simple scraping of the ground gave a satisfying representation of a field. This was rendered more real by a little activity such as lights, etc., at night, which fooled the Germans into bombing the decoy field instead of the real one.

WORK IN OTHER THEATERS OF OPERATION

Crossing the world to China, we find Brig. Gen. S. C. Godfrey, Air Engineer of the China-Burma-India Air Service Command, who has been until lately in charge for the Air Forces of airfield construction in China. The advance fields there were wholly constructed, without a single exception, from materials found locally. The one product available in almost limitless quantities was coolie manpower. At one time over 300,000 Chinese were employed in the simultaneous construction of five airfields. This was done by the laborious process of breaking stone by hand, carrying the appropriate Telford-Macadam sizes to the runway location in baskets, and placing them in the field by hand. These fields have ample load-bearing characteristics, but because of lack of proper surfacing materials they are both rough and dusty. The only practicable surface found locally, up to the present time, has been a Tung oil preparation available in limited quantities and extremely expensive. It does, however, alleviate the dust nuisance to some extent. However, within the past few months it has been found necessary to surface some airfields with asphalt, flown in for the purpose.

Considerable publicity has been given to the rather ven-turesome air-borne operations at Tsili Tsili and other locations in the Markham Valley of New Guinea, and to the Broadway landing in Burma. In the former operation, reconnaissance was made on the ground, some preparation of a field was made with the assistance of local natives and the reconnaissance party; and the Engineers with their equipment were flown in with C-47's. In the latter case, a carefully worked out program of glider landings at two locations in upper Burma—Piccadilly and Broadway—had to be aban-doned at the last moment be-cause the Japs had apparently got wind of the proposed use of Piccadilly and had obstructed the entire open space with logs. Consequently all the gliders were put in at Broadway. While this landing was suc-cessful, it did result in a number of casualties to the gliders, personnel, and materiel of the Engineers.

A report submitted by an Aviation Engineer bat-talion illustrates the construction of a typical advanced landing ground in Normandy. The battalion was assigned the job of building a landing strip 4,800 ft long by 250 ft wide with a parallel parking apron 2,000 ft long by 200 ft wide. Access roads and one drainage structure were included in the job. The reconnaissance revealed that the soil was generally sandy loam underlain by clay. The strip was laid out with a maximum grade of 1.5%. However, it crossed no less than 15 of the formidable Normandy hedgerows, and two sunken roads. Included in the area to be cleared were 11 acres of orchard and five stock-watering holes.

The clearing of the area was begun, using six D-7 and three D-8 tractors on a line 600 ft wide. Trees were topped in the approach zone to provide a 1-on-40 glide angle and a 15-deg flare angle for a distance of one mile. All clearing was accomplished with the bulldozers, although some trees were 2 ft in diameter. This phase of the work was 80% complete in 25 hours, which en-abled stripping to begin with the six D-7's, using 8-yd carryalls. As soon as the stripping of top soil was com-pleted, rough grading was begun at each end of the run-way. The water holes were pumped out, cleared by excavating all unsuitable material, and backfilled with rubble from a nearby village. The sunken roads were also filled with rubble. Spots on the runway, where the excavation uncovered the clay beneath the loam, were excavated and refilled with 3 ft of selected backfill compacted in 6-in. layers.

By the end of 51 hours of work on the fourth day, fine grading was started by motor patrols. Also on the fourth day, an L-5 observation plane landed at the south end of the runway. Final compaction following the fine grading was done by wobble-wheel and 5- to 8-ton tan-dem rollers. The compacted earth surface was usable on the fifth day, and on the same day the access roads were located and cleared. They were then graded and topped with a 6-in. gravel surface, and the entire project was completed on the sixth day, with runway markers, wind-tee, and two wind socks installed.

Engineers' Odyssey to Europe—1889

IV. Paris and Its Exposition

How American Engineers Sampled the Delights of a Foreign Capital, as Recalled by

A. Prescott Folwell, James B. French, Andrew J. Provost, Jr., *and* T. Kennard Thomson,
Members Am. Soc. C.E.

ONE of the main objectives of the large American engineering party that visited Europe in 1889 was Paris, site of the renowned Centennial Exposition and, to engineers, the even more renowned Eiffel Tower. The exposition was magnificient, the French were gracious, and the inspections were absorbing, as these reminiscences prove. But somehow the change in locale and attractions had a disruptive effect on the party as a whole. Individually the incidents were enjoyed to the full. Gradually, however, the large party began to break up and those who had composed it found their separate ways back to the United States. The final article in the series will cover this concluding phase of the trip.

FRENCH: The hour-and-a-half boat trip across the English Channel was accompanied the usual amount of seasickness. is, however, was forgotten on our rival at Calais, where we were eeted by the firing of cannon, and nd a special French train ready carry us to Paris as soon as we had ished the good lunch especially epared for us. Between Calais d Paris a stop was made at St. ner to permit the inspection of a ge hydraulic-lift installation, and arrived at Paris about 8 p.m. Thursday, June 20, 1889.

PROVOST: The Joint Party, veling de luxe, gratis, had been eeted at Calais by several past-esidents of the Société des Ingénieurs Civils de France, d by Mr. Octave Chanute, later President of the So-ty, who had preceded the party from America to as-t the European committees in formulating their pro-ams.

We reached Paris at noon of a sizzling hot day. The tels were full to overflowing with visitors to the Exposi-n. Driven to taking an apartment in the Rue de la ix, among all the fine jewelry shops, Folwell and I ok in some other homeless members of the party, and kept expenses within, or close to, our allotted daily dget. We lived there for three weeks, and each morn-had breakfast served in a court that had turf, flowers, unning fountain, and often a bird or two.

Our first thought after getting settled was for mail m home. With it was a package from the photog-pher in London to whom we had entrusted our film. contained no prints—only a very long sheet of film of gin transparency, except for a small, very black space the end, upon which had been superimposed all the nes we had snapped. The film had not unwound from reel after the first exposure.

FRENCH: The following day, Friday, was very con-erately put down as "a day of rest" by our hosts, the ench engineers. But in spite of this suggestion I visited rooms of the Société des Ingénieurs Civils in the rning; attended a reception offered our party by the itish Section at the Exposition in the afternoon (where met Professors Crandall and Thurston of Cornell); d spent the evening getting a general idea of the Ex-sition, which certainly impressed me as a grand affair.

PROVOST: In the evening, a dinner was tendered to me of the officers of the party by Mr. James Dredge, of ndon, editor of *Engineering*, who was largely respon-le for inaugurating our trip and for enlisting interest in undertaking.

On the morning of the following day the party, con-cted by members of the French Society, was taken to Exposition, where opportunity was given to view a rtion of the whole, and a few of the engineering ex-hibits. In Machinery Hall, a welcome—in French—was delivered by M. Eiffel, President of the French Society. The response—also in French—was made by Mr. Chanute.

FOLWELL: One very distinct recollection of Paris is the visit of the engineering party to the Eiffel Tower at the invitation of the French engineers, who entertained us at a luncheon on the lower stage of the tower. Ascent was by a series of elevators. Finally, as a special privilege not accorded the public, we were permitted to climb practically to the top of the structure—by a winding staircase inside a vertical steel tube.

FRENCH: We were told that from this highest point the eye could see for 85 miles in every direction. We then all descended to the *premier étage* where a "Déjeuner and Reception des Ingénieurs Américains" had been arranged by the Société des Ingénieurs Civils of France. This "déjeuner" was, in fact, an elaborate banquet (as evidenced by the menu card I still have), which with its accompaniments constituted the outstanding event in our Paris entertainment. The appreciative account of this event, as printed in the Paris edition of the *New York Herald* of Sunday, June 23, 1889, contained a full list of the American visitors. M. Eiffel presided with Mr. Whitelaw Reid, then U.S. Minister to France, at his right. Toasts were offered to President Harrison and to President Carnot, himself a civil engineer, and our Mr. Henry R. Towne responded appropriately in French. An atmosphere of international hospitality and cordial friendliness was manifested throughout.

THOMSON: One of those invited told me that he was sitting next to a Frenchman, whose American wife wanted to attend the breakfast. But he told her "*Non*—French ladies do not go to such affairs." She objected, saying that the American ladies were going. He replied, "American ladies, *oui*, but you are a French lady now—so *NON*." And she had to stay at home.

PROVOST: A gramophone recorded all the speeches made, and it was stated in the local press that the record plates were to be sent to the Society in New York for preservation. It was claimed that the taking of such records was the first to have been attempted, and that it scored another success for the Paris Exposition.

THOMSON: Speaking of the remarkable Eiffel Tower, one of the two elevators running to the top was of American design and construction. Its builder was the late Thomas E. Brown, M. Am. Soc. C.E., chief engineer for the Otis Elevator Company. I remember his saying that, to obtain this work, he felt it necessary to economize in the design, so that whenever he wanted to go up he thought it was safer to ride in the French elevator.

But one day he decided he ought to have nerve enough to try his own car—once. And the first person he saw in

SCENE AT THE FOOT OF THE EIFFEL TOWER, OUTSTANDING ENGINEERING AND SPECTACULAR FEATURE OF THE PARIS EXPOSITION
A Sumptuous "Breakfast" Was Given for the Visitors on the First *Etage* of the Tower

it was the French engineer. They compared notes, only to find that each had done the same paring and thought the other fellow's design was the safer.

FRENCH: After the déjeuner we divided into groups according to our special interests and were taken to visit corresponding portions of the Exposition under the guidance of assigned deputations of French engineers. I joined the party taken to see, and have explained to them, the exhibits relating to railroad equipment, which were very extensive and very interesting.

The remainder of our stay in Paris followed no fixed schedule. On all these visits or trips, special privileges and courtesies were extended to us as guests of the French engineers, but no real gathering of the American engineers as a whole took place after the Eiffel Tower reception and "breakfast."

THOMSON: We marveled at how clean the streets of Paris were (New York streets were anything but clean in those days). The gendarmes being always on the job, I thought it would be a sacrilege, when we were eating cherries in a cab, to throw a single cherry stone on the street.

FOLWELL: One special incident was a trip through a part of the sewer system of Paris. The entire system at that time totaled 720 miles, varying in size from 4 ft wide by 7 ft high to 18 ft wide by 16 ft high. Water mains and other conduits were carried on the walls above the water level. A narrow footway just above ordinary water level ran along one side—both sides in the case of large sewers. At each sewer intersection, signs were attached to the walls giving the names of the streets overhead.

The sewer was entered at a point near La Madeleine through a structure at the curb, similar to a small subway entrance, the door of which was kept locked. Steps led down to an inclined walk under the street, which in turn led to the sewer in the center of the street. About ten or twelve people were in our party, and we embarked in a boat that was moved down the sewer by a breast pole pushed by a man walking on the footway. After perhaps a mile of this we were transferred to a large boat, perhaps 10 ft wide, which was pushed two men, one on each side.

The large sewers were cleaned by low ing from the stern of a boat a verti board gate, the edges of which, wh lowered, paralleled the wetted perime of the sewer at a distance of two or m inches from it; water flowing rapi through this space stirred up the depo in the sewer, which was then carried alo ahead of the boat till it finally reach the outlet in the Seine. In the smal sewers a similar gate was carried by a running on rails supported by the walls. We left the sewer at the Basti through an exit similar to the entran Later a party was conveyed to Genne liers, where Paris sewage was used irrigating and fertilizing several hundr acres of land.

FRENCH: We visited the undergrou chamber housing the mechanical and el trical equipment for the control of t illumination of the fountains of the E position, which was explained and dem strated by the French engineers respon ble for its design and installation. By interlocked system of switches, the exte sive groups of fountains could be illum nated to create a variety of color combinations, and t effects could be changed as often as desired. One remar able set of effects was produced by annular orifices when issued hollow streams of water into which could be pr jected powerful rays of light of different colors. The made the emerging water appear like molten metal.

EIFFEL TOWER AS SEEN FROM THE "CHAMPS DE MARS"
Its Height of 984 Ft (300 Meters) Has Made It for Years One the World's Most Notable Structures

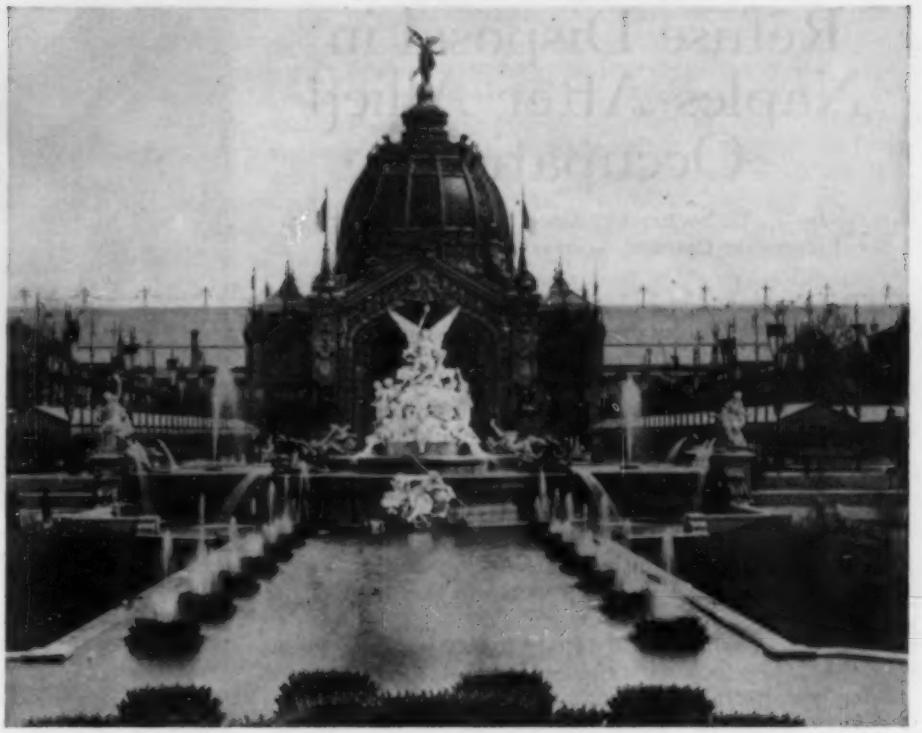
FOLWELL: An especially vivid recollection is my arrest in the Paris Exposition grounds. This has no engineering aspect, unless the immediate cause of the arrest—photographing a locomotive of unusual appearance—may be considered such. As I pushed the button ("you-push-the-button, we-do-the-rest" cameras were just coming into use) a policeman looking over my shoulder asked to see my permit. I had very little French and he had no English, but I gathered the impression that in taking photographs without having obtained a permit I had committed a serious crime.

He escorted me (politely keeping four paces in the rear with my camera in his hand) to police headquarters in a corner of the grounds, where no one admitted speaking English. I grabbed my camera from an officer's hand as he started to examine the interior, and he kindly desisted; but we got nowhere in reaching an understanding. He asked me to call the next morning, when an interpreter would be there. (It was then about 6 p.m. and Provost was waiting for me to meet him for dinner). Next morning again no one but I spoke English—and I spoke plenty. Moreover, none of the shift of the previous afternoon was present and no one seemed to have any idea what I was talking about. Finally they suggested that if I would come again the afternoon of the following day an English-speaking official would surely be present. I did and he was.

He was volubly sorry for the inconvenience caused me, explained that a license for photographing in the Exposition was "*très nécessaire*"; then took great pleasure in returning my photographic instrument and in suggesting that perhaps I would now like to purchase a license. I took equal pleasure in declining his suggestion, as I was leaving Paris the next morning; and in learning later that the films taken in the Exposition had not been spoiled by the curiosity of the police.

I could not understand why the police at an exposition visited by thousands of English and Americans kept no one on hand who spoke their language, as most Paris hotels did. I have since come to the conclusion that they did—they must have—and that they were just having a little fun at my expense. Well, in retrospect I and my friends have enjoyed it, I am sure, as much as they did (Provost hilariously enjoyed it, most of anybody); and I got my photographs without spending a sou for license, tips, bribes, or whatever.

PROVOST: On another occasion, Folwell took an umbrella to have repairs made to its handle, which in some way had been broken off. The proprietor of the shop spoke fluent English. The preliminaries were quickly arranged and a day set for the article's recovery. On that day, however, the proprietor was absent and no word of English could penetrate his representative. In this impasse, Folwell grabbed a stock umbrella, wrung its handle to signify a fracture; then with another emphatic gesture indicated replacement. The salesman was truly ecstatic, as only a Frenchman can be, and beamed "*Oui, oui, Monsieur. Demain.*" So it seemed that on the following day we were to reclaim our umbrella.



MONUMENTAL FOUNTAIN APPEARED IN FRONT OF "CHAMPS DE MARS," AT THE PARIS EXPOSITION

An Engineering Inspection showed How Flow and Illumination Were Controlled

But it was not to be. Calling on that day, Folwell was shown, with a triumphant flourish, a marvelous umbrella with a removable handle attached to which was a gleaming sword. Some time later Folwell dropped in and merely said: "*Haben sie* my umbrella *fini?*" And, that is how we recovered the useful object. Anyone who can put three languages into a mere five words, and make the whole thing click, ought to be able to recover anything, anywhere, any time.

One evening, a complimentary dinner was given to Mr. Henry R. Towne by the other members of the Executive Committee, in recognition of his energy and capacity in presiding over the interests of the party. Among the last entertainments in Paris were a musicale given one Sunday afternoon at the palace of President Carnot, and a ball tendered by the Minister of Public Works, which was enlivened by the presence of some of Buffalo Bill's Wild West Troupe.

Although other programs were announced and executed by our French friends, it began to be observable that those taking part in them became fewer. Some, saturated with technical enlightenment, sought the more cultural attractions of Paris, or of the Exposition itself; others left for travel; and many had returned home.

Some of the executive committee members went direct from Paris to London, where silver loving cups were presented to Mr. James Forrest and to Mr. James Dredge. Each of these gentlemen had been informed only that the other was to be so honored. They sailed a few days later from Liverpool on the *City of Paris* with some fifty other members of the party. Of interest in connection with that crossing is the fact that the *City of Paris* missed breaking the transatlantic record by a mere three minutes.

Refuse Disposal in Naples After Allied Occupation

By R. C. SWEENEY, ASSOC M. AM. SOC. C.E.
LIEUTENANT COLONEL, SANITARY CORPS, U.S. ARMY

THE refuse-disposal system of the Italian city of Naples has been based for many years on the return of all possible organic matter to the soil. To accomplish this the city operated a well-planned composting plant, including administration and service building, paved composting platforms, and elevated delivery and service roads. The plant is located about 5 miles from the center of the city. Collections during normal times were made by a municipally owned fleet of 70 trucks. In addition to the refuse sent to the municipal composting plant, considerable quantities of fresh refuse were always removed directly to the point of use by market gardeners and farmers.

When the Germans evacuated the city late in September 1943, they took with them a large part of the usable motor transportation, leaving the city's refuse-collection system completely demoralized. Recovery was extremely slow, and by early December the city had placed less than 20 contract trucks in the service, though it was supplementing the truck service with about 120 horse-drawn carts operated by private contractors. With the breakdown of the collection facilities, large quantities of refuse began to accumulate in the streets and alleys. The problem of removal was made more difficult because much of the garbage was thrown on piles of rubble whence it could not be completely collected without removing most of the rubble with it.

In disposing of such refuse as was collected, no attempt was made to continue the use of the composting plant because of the length of haul involved, and most of it was simply dumped on the paved parking areas of a large sports center within the city. It is probable that the Italians hoped eventually to recover the bulk of it for fertilizer.

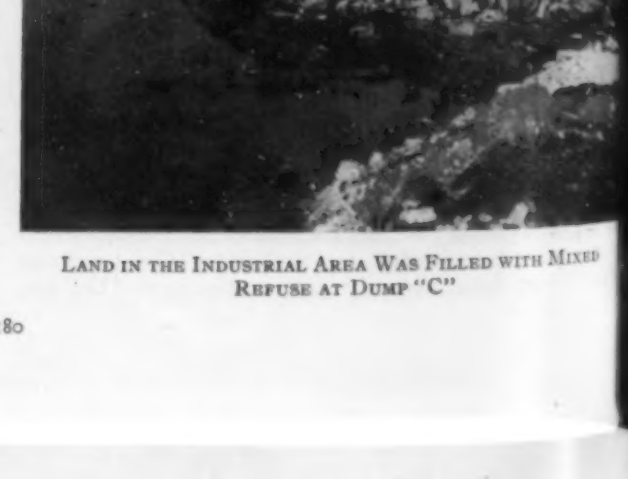
By December 1943, the Allied military population of Naples had grown enormously and the problem of the proper disposal of military refuse was becoming acute. Since the writer's headquarters operated as the housekeeping organization for the city, in so far as the Allied military personnel was concerned, the improvement of the entire situation was a problem which fell to the writer's section. However, since the municipality was involved, joint action was taken with the Health and Welfare Section of the Allied Military Government group.

BOTH ARMY AND CIVILIAN VEHICLES HAULED REFUSE TO APPROVED DUMPING AREAS

THE TRANSPORTATION BOTTLENECK

In considering workable plans it was evident that the controlling factor in the disposal of civilian refuse was the limited transportation available to the city, indicating the necessity for short hauls whenever possible. Within reason, length of haul and transportation was not a factor in the disposal of military refuse. As there were thousands of cubic yards of rubble from bombed buildings still to be disposed of, it appeared feasible to establish a number of dumps of the fill-and-cover type using rubble for top sealing. Eventually six locations, scattered throughout the city, were selected and established as joint military-civilian refuse dumps. These were placed under military supervision and operated by

SURFACE OF DUMP "B" WAS GRADED TO PROVIDE A MILITARY TRUCK PARK



LAND IN THE INDUSTRIAL AREA WAS FILLED WITH MIXED REFUSE AT DUMP "C"

LOADING GARBAGE ON A BARGE FOR DISPOSAL AT SEA BY CIVILIAN CONTRACTORS

labor furnished by the city. Two of the locations were such that they received primarily military refuse, and one was an old city dump that was revived when the operation of the composting plant was discontinued. The latter was difficult to operate because of the depth of dump face.

The service was further supplemented by awarding a contract to a local marine contractor to barge some civilian garbage from water-front areas to the sea. Only a short sea haul of about 2 miles was specified, both for security reasons and to speed up disposal. It was realized that there would be some wash-back on shore from such a distance, but at that time it was preferable to having accumulations continue in streets and alleys. The barge contractor's equipment was not entirely suitable; his operations were difficult to control; and with the advent of warm weather and the use of the local bathing beaches, the contract was terminated.

REFUSE CONTAINERS DISTRIBUTED

With the establishment of the new disposal points, stringent efforts were made to have the city increase the amount of equipment in use in the collection service, and to otherwise facilitate collections. As a part of the latter program, the Army furnished hundreds of salvaged metal drums to the city; these were distributed throughout the poorer sections in an effort to eliminate the practice of throwing waste material into rubble piles, from which its collection was difficult.

Municipal requirements for such operations as street and sewer work and the movement of food were enormous. Even with the requisition of private trucks, it was not until early June that the municipal refuse-collection system was keeping even with civilian production. At that time approximately 60 city trucks and 220 horse-drawn carts were in use, with daily collections averaging about 1,400 cu meters. The latter figure does not include the quantities that were being removed daily by individual farmers and market gardeners, who would collect a load along the route of their return to their homes after delivering a load of produce to the market places. While these individuals as a group removed considerable quantities of material daily, their contribution to the cleanliness of the city was not all that it might have been because of their practice of discarding and leaving at the collection points all tin cans and other materials of no fertilizing value.

Throughout the period January to June 1944, municipal collections were supplemented by 5 to 15 military trucks operating daily under the direction of the Headquarters Sanitation Section. This military equipment was primarily engaged in catching up on the backlog in the poorer, congested sections of the city where there were large accumulations of mixed garbage and rubble. By the end of June 1944, most of the backlog had been disposed of, including the large accumulation in the sports-center area. Much of the material handled by the military equipment was used in the mosquito-control program as fill for bomb craters in sections of the city where the ground-water table was high, and where mosquito breeding was taking place in the craters.

DISPOSAL OF MILITARY WASTES

During all this period, further aid was given to the city by issuing a directive that all local Allied military units would utilize their own equipment and personnel for the transportation and disposal of their military wastes and would not call on the municipality for such service.

In general, the fill-and-cover principle worked very satisfactorily, particularly on those operations where the depth of fill did not exceed 12 to 15 ft. On all the dumps a clean rubble top and side seal of not less than 24 in. was maintained. Such a depth of seal was entirely effective in controlling flies and rats. The major source of difficulty in operating the dumps was controlling the activities of individual civilian salvagers. While the Army made an effort to salvage at the source all materials of value, considerable quantities of cardboard, wooden boxes, small wood scraps, and other miscellaneous items of use to the Italians, came to these dumps. Until military police controlled the situation, civilians swarmed over every military truck as it came into the dump area

FILL AT DUMP "C" WAS COVERED WITH DIRT TO PROVIDE A WELL-GRADED STORAGE AREA

and threw off materials in the hope of retrieving some item worth saving. Such activities, until they were stopped, required continuous and extensive area clean-ups which were not required when the entire loads were dumped at the face of the fill.

The dumps during their life disposed of large quantities of material. Dump "B," when completed on July 1, 1944, contained approximately 60,000 cu yd of material, and the site had been placed in service as a military truck park having a surface area of about 120,000 sq ft. The area had been brought to the grade of the adjacent streets and gave entrance to a sizable industrial area without the necessity of using a dangerous grade rail crossing. Dump "C" at the same time had received approximately 40,000 cu yd of material and was reclaiming for future industrial use a large area which prior to this operation had lain well below the adjacent street grade.

Proposed Substitute for River Valley Authorities

By J. C. STEVENS, PRESIDENT, AM. SOC. C.E.
STEVENS AND KOON, CONSULTING ENGINEERS, PORTLAND, ORE.
and W. W. HORNER, M. AM. SOC. C.E.
HORNER AND SHIFRIN, CONSULTING ENGINEERS, ST. LOUIS, MO.

THE expansion of the "Valley Authority" idea to other basins than the Tennessee is apparently not universally acceptable. It is considered to be in conflict with the many state interests and to threaten the abrogation of certain state rights, particularly those of water, which have been jealously guarded since the founding of the country. The "Authority" principle is decidedly undemocratic, since all development is in the hands of a small group appointed by the President, with no direct responsibility to the people of the basin. Congress does little more than supply the funds. Once established, a Valley Authority is a federally sanctioned dictatorship, as regards both physical and financial control of the entire river basin.

TO SEPARATE PLANNING FROM OTHER FUNCTIONS

The preparation of a comprehensive plan of development of the water resources in a river basin, with justice to all interests concerned, cannot be accomplished unless the affected states have an opportunity to participate in the proceedings and join an authoritative agency in the preparation of that comprehensive plan. Such an agency's authority should be limited to the preparation of the plan. There is no necessity whatsoever for giving it the additional authority to construct, operate, and maintain the projects after their completion. These responsibilities should be assigned to the various federal and state offices in whose field of action they naturally fall. The agency's only continuing authority would be to see that these projects are operated for the purpose, and in the manner, originally proposed and to pass on changes subsequently proposed in the comprehensive plan.

Coordination of operation can be insured by mutual agreements between operating agencies such as are now in evidence between the Bureau of Reclamation, the U.S. Corps of Engineers, and the Bonneville Administration in the Columbia River Basin. The Northwest Power Pool is another case in point, wherein private, federal, and municipal power generation and distribution are completely controlled by a Power Pool Committee on which each power agency is represented.

NEW AGENCY—BASIN DEVELOPMENT COUNCIL

To effectuate such a program it is herein proposed that Congress shall create river basin agencies to be known as Basin Development Councils—for example, the Columbia Basin Development Council. The duty of such a Council would be to prepare the comprehensive plan for the development of the water resources of the river basin in question. Such a Council would actually be an "Authority" in so far as the development of a comprehensive river basin plan is concerned, but its powers would be definitely restricted to that function. Once the plan has been prepared and adopted, Congress would make appropriations for such units thereof as it should determine, and authorize the proper agency to proceed with development.

The Council should contain one representative of each interested federal department—notably the U. S. Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service, the Federal Power Commission, the U.S. Health Service. It would also include one representative from each of the states in the basin appointed by the respective governors. As directly representative of the general public, there would be added a number of civilians appointed by the President, including a civil engineer, an attorney, an economist, a banker, and a representative of labor, one of which would be designated as President of the Council.

OBJECTIVE, THE BASIN PLAN

Detailed work of the Council would be carried on by an Executive Committee of five members who would devote their entire time to the work and receive adequate compensation therefor. The federal and state members of the Council would be paid by the government and the states, respectively, and the civilian members would receive compensation from the Council commensurate with the services rendered.

The first step in the development of the plan would be a review of all of the investigations and proposals heretofore made by federal, state, and private agencies. Additional investigations would undoubtedly be necessary. They would be made by the several agencies under the advice and direction of the Council or, if necessary, directly by the Council itself.

The Council would have no need to develop a superorganization of its own, but a moderate staff would suffice to analyze the proposals submitted and coordinate them into a workable whole. When a comprehensive plan for the development and control of the waters of the basin had been prepared and adopted by the Council, it would become "the Basin Plan" and thereafter no project would be constructed within the basin not in harmony therewith as finally determined by the Council.

COORDINATING THE PROPOSED PLAN WITH EXISTING PROCEDURES

Carrying out of the plan, that is, actual construction and operation of the specific projects involved, would be the function of existing agencies as designated by the Council. Construction of federal projects would be carried out upon authorization and appropriation by Congress as a part of the regular program of the particular federal department concerned. Projects designated as strictly state would be constructed and operated by state agencies upon authorization and appropriation by state legislatures, while certain projects might be cooperative enterprises between federal and state governments. Under coordinating procedures which the Council would outline on interstate streams, encouragement and aid would be extended to the states in the development of interstate compacts for the settlement of water disputes rather than by extended litigation.

The program as outlined would be fully democratic in its background and would have the further advantages of using efficiently existing organizations within the fields where they have experience and capability. The enabling act setting up such a Council should give it such authority and funds as are necessary to carry out the purposes contemplated herein.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Blasting Necessary in Dismantling Bombproof Power Station

By BERNARD R. CORDES, YEOMAN 1ST CLASS, C. B., U.S. NAVY

WITH the shifting of the theater of operations in the Pacific, it became desirable to dismantle and relocate a 3,000-kva diesel-electric power station. The station had been located underground for emergency use during a period when it appeared possible that surface installations might be in danger. Because of completely bombproof barriers at all entrances, it was a major operation to break into the station.

INTERIOR OF POWER STATION BEFORE DISMANTLING

The underground room was tunneled out of solid rock and sealed with an offset barrier made up of two reinforced concrete walls 4 ft thick (Fig. 1). It was required that the engines be moved intact to avoid possible damage to machined surfaces. It was possible to maneuver the bulky equipment within the tunnel but large units could not be taken through the doors in the barrier.

BARRIER DEMOLISHED BY EXPLOSIVES

Demolition of the barrier was therefore essential. Alinement of equipment and doors made it desirable to blast a doorway in line with the aisle within the station. Two blasts were required because of heavy reinforcement in the barrier. The first blast opened a hole through the entire 4 ft of concrete and exposed the reinforcement. The second blast trimmed the opening to the necessary dimensions. The steel doors inside the center barrier protected the equipment from damage by the blasts.

The engine nearest the tunnel entrance was of course the first to be moved. It was raised from its mount by four hydraulic jacks, placed under the base in openings broken out with jackhammers. The engine was placed on rollers and pulled, by the winch of a tractor, onto a pair of 16 by 24-in. timber skids, which had been previously placed on a well-greased steel plate. The

OBSERVING RESULTS OF THE FIRST BLAST, WHICH EXPOSED REINFORCEMENT

A Second Blast Trimmed the Opening in the 4-Ft-Thick Wall

skids were then bolted to the engine. Additional greased plates were placed beside the first plate, in a series, so that the engine could slide along on them.

In order to get the engine in position to be pulled through the blasted opening, it was necessary to move

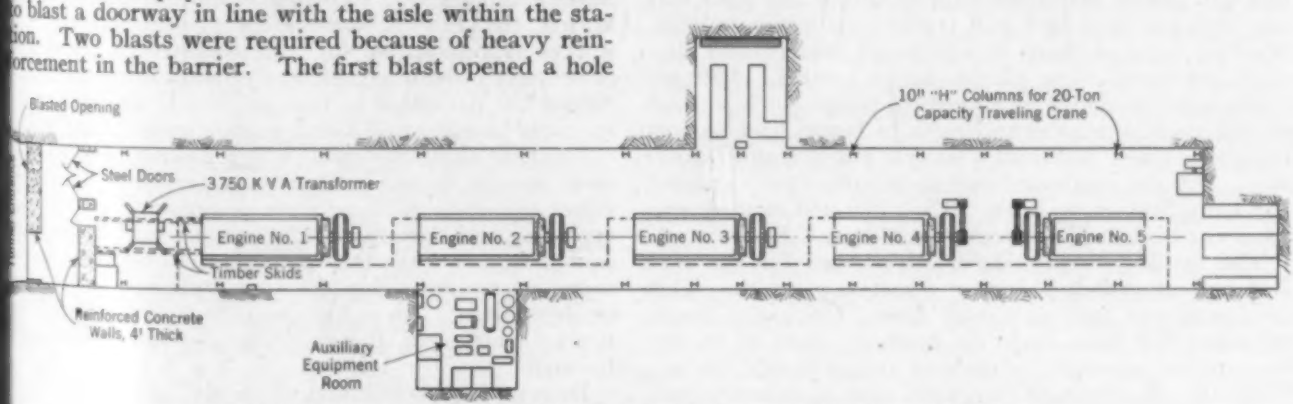
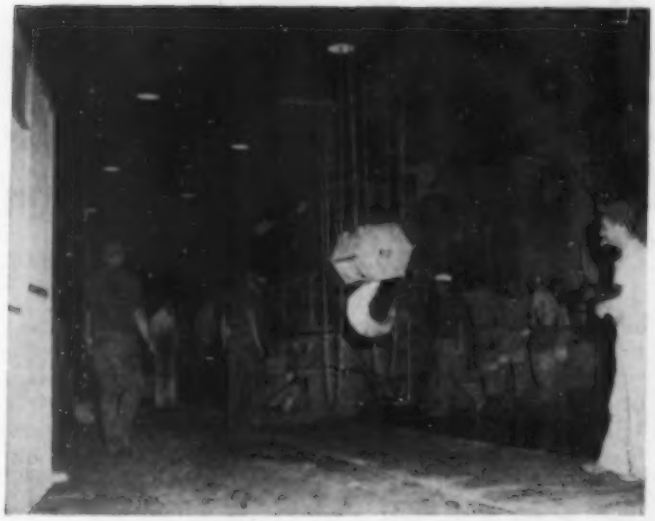


FIG. 1. PLAN OF DIESEL GENERATING PLANT LOCATED IN BOMBPROOF CHAMBER



ENGINE BEING LIFTED ONTO TIMBER SKIDS, PREPARATORY TO BEING PULLED OVER GREASED STEEL PLATES

it sidewise about 3 ft. This was done by means of a winch cable, running alternately through a sheave secured to an H-beam opposite the front of the engine, and then through a sheave opposite the rear of the engine. While the front end was being moved, the rear end had to be blocked up in order to prevent it from moving to the rear, and vice versa. The engine was pulled through the blasted opening by two tractors using the steel plates under the skids to cut down friction. The tractors then hauled it to the place where it was to be crated. All underground piping cables were removed and crated.

TRACK BUILT BETWEEN ENGINE MOUNTS

After the first engine had been taken out of its mount, the generator mount was removed with jackhammers and a track was built up between the engine mounts. Each engine in turn was drawn from its position up to the front of the room, and placed on skids in the location where the first engine had been so mounted. This procedure was necessary because of the excessive work involved in jacking the engines high enough above their mounts to allow them to be moved laterally to a position over the skids. There was not enough space between the engine mounts to allow the engines to be placed on skids initially, so all the engines were brought to the front position first.

One of the requirements of the job was to make sure that the parts from each engine were crated with the engine from which they had been taken. To insure this, each engine was given an identifying color and each component part was paint-striped accordingly. The markings were indicated on the master materials list sent along to facilitate the reassembling of the equipment at its destination.

Red Ball Highway—Artery to Western Front

By GEORGE H. BARTON, ASSOC. M. AM. SOC. C.E.
CAPTAIN, CORPS OF ENGINEERS, U.S. ARMY

SHORTLY after the Normandy break-through and as the front advanced, the now famous Red Ball Highway was established in France to supply the fighting troops with ammunition, gasoline, rations, and other supplies necessary to wage successful warfare against the enemy. Rail lines had been cut, bridges were out, marshaling yards were blocked. Thus it was necessary to rely on motor transport. More than 500,000 tons of freight were hauled over this vital link.

The eastbound Red Ball carrying supplies to the front came under the supervision of the Loire Section. Freight passing over this segment was loaded on trucks at the beaches or at Cherbourg and routed east to the front in convoys by serials. Constant speeds were maintained, the convoy halting at stated intervals for first-echelon truck maintenance and brief rest periods. The highway was well posted with signs indicating that the route was one way and that Red Ball traffic only was permitted. Warning signs of sharp curves, rough craters, and slippery pavement were placed where needed. Military Police were stationed at all critical points, such as road intersections, entrances and exits to towns, and narrow bridges. These MP's did a superb job of traffic regulation. For the westbound or return route, trucks entered the Loire Section at Ablis. All traffic and routing was supervised by the Transportation Corps, U.S. Army.

The existing French highways selected for the Red Ball had an asphalt pavement 6 meters in width. This pavement was laid on a rock base. Originally ample provision had been made for drainage, both as to sufficiency and location of structures and as to side ditches. Generally all drainage structures were of masonry arch onstruction, and some date back several centuries.

The alinement of the highway would not be considered good under modern standards, as curves are sharp and sight distance is poor. This is further complicated by narrow entrances and exits to towns and villages, as well as by narrow streets and right-angle turns. No bypasses were feasible under existing conditions, in view of the time element involved. Grades generally over the route did not exceed 7%. However, the combination of alinement and grade tended to slow traffic along certain stretches as well as to create hazards of operation.

PREVIOUS CONDITION OF THE ROUTE

During German occupation, normal maintenance on the highway had been greatly reduced. Although drainage work had been carried on, surface treatment involving needed application of asphalt was omitted. Surface repairs had consisted mainly of patching, following the French *cantonnière* system whereby one worker is responsible for approximately 6 kilometers. Absence of constant traffic and of surface treatment had caused the pavement to become "dead" and thus ready for rapid raveling and disintegration under heavy traffic.

Fighting along the road, which preceded its use as a main supply route, left many crater holes caused by mines and bombs, damage to pavement from vehicles exploding and burning up in place and from bullet holes caused by plane strafing and other machine-gun operations. A number of bridges were destroyed by bombing or demolition; these had been hurriedly replaced by timber trestles or Bailey bridges as the Army went through.

Heavy Army traffic and the early supply traffic (before any but the most necessary repair could be effected)

caused rapid disintegration in the form of raveling and large pot holes. Side drainage was badly mutilated owing to necessary convoy parking on shoulders and in shallow side ditches.

Some of the major problems confronting repair and maintenance units have already been mentioned. These were further accentuated by constant heavy traffic, making it extremely difficult and hazardous to work. Lack of operating quarries to provide proper and sufficient rock for patching necessitated the use of small stock piles of stone that had been spotted along the route and side roads for normal repair.

A major problem in the early stages of operation was the lack of suitable equipment for the type of work involved. Virtually no equipment for asphalt work (other than a few small items obtained from French authorities) was immediately available.

For repair and maintenance of both eastbound and westbound routes, there was available to the Loire Section one battalion from the 365th Engineer General Service Regiment. Because of the condition of the highway, proper and ample equipment was necessary at once to carry out the work satisfactorily on 275 km. This equipment was brought in from the beaches.

Disintegration was accelerated on the eastbound route because the "payload" traveled this route as compared with "empties" on the westbound; thus two companies of troops were assigned to the eastbound route and one company to the westbound. A coordinated plan of action was set up and followed, which included the following provisions:

1. Each platoon was allotted a definite section of road, based on the condition of the road and the anticipated necessary work.

2. The platoons were broken down, utilizing squad organization, into three working road-repair groups, each group served by one dump truck.

3. Platoon and squad leaders were furnished with simply phrased instructions as to performance of the work involved. Platoons were supplied with necessary tools, brooms, and one "Littleford" asphalt kettle each complete with sprayer. Platoon activity was supervised by company commanders and the battalion commander.

4. A central asphalt plant was set up to provide a controlled premix for replacement of surfaces over crater holes and for pot-hole patching. This plant produced at the rate of 50 tons of premix material in 8 hours.

The plant was located in an existing quarry that had a stock pile of several thousand tons of 3-in. rock, accumulated under German occupation. This rock, a type of trap well suited for the work involved, was loaded by an R-4 bulldozer onto a timber ramp set into the stock pile, then gravity fed into a mobile secondary rock crusher adjusted to provide crusher run from $1^1/_4$ in. down to fines. From the crusher, rock went by conveyor to a bin, thence to a mechanically driven rotary drum drier, thence to a portable mixer. Asphalt (RC-3) was supplied by hose from a 1,250-gal distributor stationed near the mixer. Since the mixer had been damaged by idle fire, it was necessary to utilize the distributor for heating and supplying asphalt. From the mixer, premix was loaded into trucks by gravity. It was found that the run of the crusher, including all fines, provided the best all-purpose mix under existing conditions. By weight, 5% of asphalt was used in the mix, but this percentage was varied slightly from time to time.

One platoon operated the premix plant, and provided tips for seal coating and skin patching. The premix plant was the first, and up to the time of writing, the only complete premixing installation operated on the continent by the U.S. Army.

PREMIX ASPHALT PLANT WAS LOCATED IN A QUARRY

5. Coordination between plant and working crews was of primary importance, in order that the plant might not be kept waiting for trucks, or the truck crews kept waiting for the premix. This was accomplished by stockpiling small quantities at sites that would probably be worked on within a 48-hour period.

The following types of work were performed:

(*a*) Replacing the surface over craters, and pot-hole patching using premix—or roadside mix for the most easterly part of the routes.

(*b*) Seal-coating raveled areas and those areas beginning to show disintegration, but not to the pot-hole stage.

(*c*) Drainage, consisting of reopening side ditches, also continuous maintenance of the small French side drains which extend from the metal roadway surface across the shoulders to the side ditches. This last was a constant operation because of their intermittent destruction by convoy parking.

(*d*) Bridge rehabilitation and maintenance.

(*e*) On rainy days, when it was impractical to make an asphalt patch, an expedient patch consisting of a mixture of clay and fine gravel was placed in the larger chuck holes as a temporary measure. This expedient patching prevented many accidents, speeded up traffic, and was directly reflected in reduced Ordnance maintenance of vehicles.

(*f*) Mud removal at service points and bivouac areas. After the rainy season set in, much emphasis was placed on drainage, particularly in keeping open side drains mentioned in item (*c*) above, in order to prevent water from seeping below the pavement and causing further disintegration. On days when it was impractical to do asphalt work, drainage received first priority.

6. For each working crew, an MP was provided to control traffic while it passed the site of the work in order to avoid accidents and protect workmen. The MP was furnished with a "Maintenance" sign, which was placed approximately 200 ft to the rear of the group and facing traffic.

The Red Ball Highway in the Loire Section has probably been subjected to as heavy and concentrated traffic as any similar highway in history and has stood up remarkably well with the maintenance provided. Vehicles using the highway ranged from jeeps to 70-ton (loaded) tank retrievers, and included half tracks as well as every other type of motorized vehicle used by the U.S. Army.

SOCIETY AFFAIRS

Official and Semi-Official

More Society Assistance

THE SOCIETY should and does respond to many calls for assistance coming from members of the engineering profession. Two recent instances may be cited, both in connection with proposed state legislation affecting engineers. It will be noted that the support of the specific legislative bills was by citizens of the state, while information concerning the Society's documents on which the bills were based was furnished by a member of the Society's Headquarters staff.

In January, the Massachusetts State Engineers' Association, Inc., introduced a bill in the Massachusetts Legislature calling for an increase in the salaries of engineers in state employ. Its recommended salaries were based on the Society's Classification and Compensation Plan adopted by the Board of Direction July 18, 1944 (CIVIL ENGINEERING, August 1944).

A legislative committee hearing was held February 1 in Boston. Upon request of the Massachusetts State Engineers' Association, Allen P. Richmond, of the Society's staff, attended the hearing and explained the authoritativeness of the Society's Classification and Compensation Plan.

The Northeastern Section was represented by Prof. Emil A. Gramstorff, member of the Section's executive committee. The chairman of the Section's Committee on Employment Conditions, Oscar S. Bray, also attended the hearing. They spoke, however, as citizens of the state and as registered professional engineers in Massachusetts. Many engineers employed by the state spoke in support of the bill. No opposition was voiced at the hearing.

Two weeks later, assistance was given in another state in a different field. Mr. Richmond attended a judicial committee hearing in Concord, N.H., at the request of Representative Ned Spaulding, consulting engineer, who had introduced a bill providing for registration for professional engineers and land surveyors. (At present, New Hampshire and Montana are the only states without engineering registration laws.) The bill as originally introduced in the New Hampshire legislature was essentially the latest edition of the Model Registration Law.

It was the function of the staff member to indicate the authoritativeness of the basic Model Registration Law, to answer questions as to the workings of registration laws in other states, and to estimate, upon request, the probable effect of amendments which were proposed during the hearing to make the New Hampshire bill more acceptable for the initiation of engineering registration in the state.

Among the many engineers who appeared in support of the proposed bill, as amended, were Representative Spaulding; Mr. Williams, Chief Engineer, Public Service Company of New Hampshire; P. A. Shaw, M. Am. Soc. C.E., Engineer and Superintendent, Manchester Water Works; Commissioner F. E. Everett, M. Am. Soc. C.E., of the New Hampshire State Highway Department; Daniel Dickinson, Chief Engineer, New Hampshire State Highway Department; Harold Langley, Bridge Engineer, New Hampshire State Highway Department; and many others. Two architects also gave wholehearted support to the bill as amended. Professor Albert Haertlein, M. Am. Soc. C.E., secretary of the Massachusetts State Board of Professional Engineers and Land Surveyors, also appeared by request and described the experience of the Massachusetts Board in administering its registration law. No opposition to the bill as amended was voiced at the hearing.

Second vice-chairman of the New Hampshire judiciary committee is Representative Charles A. Holden, M. Am. Soc. C.E. His counsel to the staff member was very helpful in preparing material for presentation to the judiciary committee. It is interesting to note that there is no state engineering society in New Hampshire.

E.C.P.D. Issues Twelfth Annual Report

AMONG current activities noted in the Twelfth Annual Report of the Engineer's Council for Professional Development are vocational guidance for returning veterans and a plan for accrediting the programs of technical institutes. The report covers all Council matters up to September 30, 1944.

According to the report of the Committee on Student Selection and Guidance, "to serve the veterans adequately will require all the facilities at our command and will involve a considerable expansion of our subcommittee structure. . . . Veterans are gravitating naturally to facilities existent in their own localities. . . . Guidance, particularly of an informational character, should be made available to high school principals and guidance officers. Informational material should be given concerning the profession, its requirements and responsibilities, college and Veterans Administration centers where engineering tests are given, and a list of local subcommittees of this committee. . . . A pilot survey of some two hundred high schools in New York State reveals that these schools need and want this information. The fact that there are 25,000 high schools in the United States gives an idea of the scope of the problem."

The measurement and guidance project of the Committee, which is being carried on under the direction of the Carnegie Foundation for the Advancement of Teaching, is directed to the development of a battery of tests to aid in the proper selection of students for engineering. During the first year of operation of the project, eleven colleges of engineering cooperated in the work. Fifteen institutions in the United States and Canada have evidenced interest, and their inclusion in the projects awaits official sanction of the Advisory Committee. It is planned to extend the services offered by the project, as the Carnegie Foundation feels that the tests are now sufficiently developed to warrant a considerably wider application.

Accreditation of the curricula of engineering colleges, which has been the major activity of the Committee on Engineering Schools for many years, was held to a minimum last year because "the Committee believes that engineering colleges cannot be fairly judged while operating under war conditions."

The Subcommittee on Technical Institutes completed an inclusive study of the present status of education of the technical institute type in April 1944, and a new subcommittee has been appointed to bridge over the war period and to formulate plans for accrediting educational programs of the technical-institute type.

A revised "Reading List for Junior Engineers" was a significant contribution of the Committee on Professional Training during the year.

Principal developments during the year affecting employment conditions of engineers in the United States and Canada are covered in a report of a special committee of E.C.P.D.

What E.C.P.D. can do to make the program of professional development more effective, and what the constituent organizations did during the year toward furthering the objectives of E.C.P.D., are covered in brief reports submitted by representatives of these organizations.

The Engineers' Council for Professional Development is a conference organized to enhance the professional status of the engineer through the cooperative efforts of the following national organizations concerned with the professional, technical, educational, and legislative phases of engineers' lives: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, Engineering Institute of Canada, Society for the Promotion of Engineering Education, American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners.

The development of procedures to be recommended to the sponsoring organizations and the administration of such procedures as are approved, function through the standing committees on Student Selection and Guidance, Engineering Schools, Professional Training, and Professional Recognition, or through special committees set up from time to time.

The objectives of E.C.P.D. are to coordinate and promote efforts to attain higher standards of education and practice, greater solidarity of the engineering profession, and greater effectiveness in dealing with technical, economic, and social problems.

The headquarters of E.C.P.D. are maintained in the Engineering Societies Building, 25–33 West 39th Street, New York 18, N.Y. Copies of the Twelfth Annual Report may be obtained by addressing the Secretary, R. L. Sackett, M. Am. Soc. C.E.

NOTES FROM THE CAPITAL

Occasional Information Transmitted by the Society's Washington Representative and Believed to Be of Special Interest to Civil Engineers.

Senate Committee Informed of Need for Postwar Plans

Activities of the Society's Committee on Postwar Construction were described at the February 22 meeting of the Senate Committee on Appropriations by E. L. Chandler, the representative of the Society in Washington. In Mr. Chandler's statement, which follows, he refers to "Title V of the War Mobilization and Reconversion Act of 1944." This section of the Act authorizes "loans or advances to the States and their agencies and political subdivisions to aid in financing the cost of architectural, engineering, and economic investigations and studies, designs, plans, working drawings, specifications, procedures, and other action preliminary to the construction of public works."

THIS STATEMENT is presented in behalf of the American Society of Civil Engineers, an organization composed of more than 20,000 individual members. Membership is found in every state in the Union.

We are aware of the important part that construction plays in the peacetime national economy of the nation and are deeply concerned that there be an adequate amount of planning done before the return of peace. The Society has a Committee on Postwar Construction which is engaged in the stimulation of planning throughout the country. The Committee works through the Society's 64 Local Sections. As the result of this activity, we believe we have a good understanding of the trend in planning and can speak with knowledge of the necessity for prompt planning of public works.

A NORMAL CONSTRUCTION PROGRAM

Past records indicate that construction normally comprises from 10% to 15% of the total national economy. On that basis, it will be necessary to carry out approximately $15,000,000,000 of construction work per year after the war, if construction is to contribute its normal share. It does not appear necessary to dwell here upon the possibility of serious economic depression after the war unless thorough preparation to guard against such a condition is made. Much testimony on that subject has been presented to Congressional Committees and the information so accumulated is readily available.

A construction program of $15,000,000,000 per year will provide on-site and off-site jobs for approximately 7,500,000 people. Expressed in other terms, this means a living for perhaps 25,000,000 of our citizens.

History indicates that a balanced construction program for the nation normally requires that approximately one-third of the total be in the field of public works. This means that we should look forward to $5,000,000,000 annually of public works construction, in a well-balanced national economy. It is obvious that construction cannot be undertaken until plans for construction projects are prepared and ready for execution. Plans must be ready in advance. Planning for the type of construction project to be found in the field of public works frequently requires more time than the actual construction. Engineers know that to be a fact. Experience during the early days of PWA proved it beyond question. In spite of the availability of money for construction when the PWA program was inaugurated, it was found possible to furnish construction jobs for only about 100,000 people at the end of eighteen months because of the time required for plan preparation. Unless adequate planning for postwar construction is done prior to the end of the war, there is bound to be a corresponding lag. Prompt action to stimulate planning is necessary.

Our records show that as of February 6, 1945, only $6,771,000,000 of construction projects had been reported as having reached the planning stage and that $535,400,000 covers the total volume reported as completely planned and ready for construction. This is a distressingly small figure. Unless planning is stimulated, and proceeds at an accelerating rate, we will be confronted with a grave situation when peace comes.

A few states have found themselves financially able to proceed with substantial planning. Some of the others should be doing better than they are. Some are not able to provide funds for adequate planning at the present time. In the areas covered in the second and third categories mentioned, there is evident need for stimulation and assistance. Delay will be costly. In many instances, the lack of planning does not result from lack of realization of the need, or lack of a desire to proceed. Legal and legislative obstacles frequently stand in the way of appropriation of funds for planning by municipalities, by special districts, and the like. We are not aware of such obstacles to prevent local agencies from availing themselves of the type of assistance contemplated in Title V of the War Mobilization and Reconversion Act of 1944.

We are not advocating Federal grants for purposes of construction. We are not even advocating gifts of Federal funds for the planning of local public works. We do believe in the soundness of the provisions of Title V, which authorizes the advancing of Federal funds to local governmental agencies to assist them in the planning of sound public works projects for postwar construction, with the provision that money so advanced be returned to the Federal Treasury when funds for construction shall have become available.

The fact that complete victory over the enemies of our country has not recently seemed as close at hand as was thought likely a few months ago is no reason at all for relaxing efforts to complete the planning for an adequate volume of postwar construction projects. Many were over-optimistic as to the progress of the war in 1944, and have since come to take the pessimistic view that the end of the war is far distant. Who can say, in the light of current events in Europe, that Germany may not capitulate in the very near future? Even if it is granted that victory may be delayed for a few months, or a year, or for whatever the time may be, it is still certain that we will have to face postwar conditions sooner or later.

PLANNING TO AVOID DEPRESSION

The current slow rate of planning throughout the country makes it evident that there must be an acceleration if a sufficient volume of construction is to be completely planned and ready for execution with the coming of peace. Construction plays such an important part in the life of the country, that an inadequate volume of construction activity can unbalance our entire economic structure and again result in the kind of depression which is so vivid in our memories of the 1930's. Construction cannot be a panacea, but it can do much to stabilize our postwar economy if enabled to take its proper place in the life of the country.

The amount recommended for appropriation by President Roosevelt is a very modest amount for this highly important purpose. If $75,000,000 be appropriated and the entire amount be utilized for planning, it would be sufficient to increase the volume of postwar projects by $1,500,000,000. If such an amount of construction be made ready for execution in the first postwar year, it will provide more than 700,000 jobs for people who will, otherwise be jobless. Without such provision, there is little doubt but that federal funds will be demanded for unnecessary work or for a dole to an extent that will far overbalance the amount of appropriation under consideration.

NOTES FROM THE CAPITAL
(Continued)

Federal Works Agency Reorganized

ADJUSTMENTS of interest to the construction industry recently have been made in the organization framework of the Federal Works Agency. These adjustments place the Nation's No. 1 engineering and construction agency in a position to handle effectively an expanded federal postwar construction program. Under its new organization and for that part of the postwar program assigned to it, FWA can exert control in a manner which will assure that federally aided public construction will complement but not compete with private construction for available manpower and materials. The principal changes in the FWA set-up are the creation of a new bureau, the Bureau of Community Facilities, and the reforming of boundaries of field office jurisdiction so that they are the same for all three FWA bureaus.

FWA retains two of the bureaus it had from its beginning—the Public Roads Administration and the Public Buildings Administration. The creation of the new Bureau of Community Facilities actually did little more than give a new name and somewhat expanded potential duties to the existing branch of FWA which has had, and still has, charge of the so-called Lanham Act Community Facilities program. No new field offices have been organized, nor has the number of employees been increased either in the field or in Washington. The creation of the new bureau has actually resulted in a decrease in the total number of employees.

Under the Lanham Act program, the Administrator of FWA has directly carried out a five-hundred-million-dollar construction program comprising the construction of local hospitals, schools, water works, sewers, etc., in communities where the impact of a war-induced population was great. This work has been done under the contract system and will so continue under the new Bureau of Community Facilities.

The field personnel now under the new bureau have had years of experience in dealing directly with municipalities in connection with federally aided public works. For this reason the field offices of the new Bureau of Community Facilities will conduct negotiations and review applications from municipalities in connection with the disbursing of such federal funds as may become available for aid to municipalities in planning postwar public works.

The functions of the Public Roads Administration and the Public Buildings Administration are too well known to warrant explanation here. Should there be a federally aided, postwar, municipal public works construction program under FWA, the Bureau of Community Facilities will supervise only the construction which could not normally be supervised by the two older FWA bureaus. Creation of a new bureau or agency to handle postwar public construction will be unnecessary. In such a construction program, the federal interest in it would be supervised as follows: all buildings by PBA, all city street and highway construction by PRA, and all other types of municipal public works by the Bureau of Community Facilities.

In order to provide for decentralization of the three bureaus of FWA and to assure cooperation among its field forces, the FWA Administrator has divided the field into nine division areas. In each division a single headquarters city has been named which will be the division headquarters of the Division Engineers of all three bureaus in that division. Boundaries of the several divisions are now identical, whereas, previous to this reorganization, the limits of divisions for the different Bureaus did not correspond, and field offices for a given area frequently were widely separated. Where the work load requires, any Bureau may subdivide its divisions into districts headed by District Engineers. Under this decentralized operating organization already in existence, and with close coordination in the field divisions, the Federal Works Agency as a whole can be contracted as events warrant or it can be quickly expanded when necessary for the prompt discharge of existing postwar responsibilities as well as possible future postwar duties which Congress or the President may assign to the Agency.

The states comprising the nine division areas of FWA and the headquarters city in each division are as follows:

Division No. 1. Headquarters: New York, N. Y.
Includes Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey

Division No. 2. Headquarters, Washington, D.C.
Includes Pennsylvania, Maryland, Delaware, Virginia, W Virginia, District of Columbia

Division No. 3. Headquarters: Atlanta, Ga.
Includes North Carolina, South Carolina, Georgia, Flori Tennessee, Alabama, Mississippi

Division No. 4. Headquarters: Chicago, Ill.
Includes Ohio, Kentucky, Indiana, Michigan, Illinois, Wiscon

Division No. 5. Headquarters: Kansas City, Mo.
Includes Minnesota, Iowa, Missouri, North Dakota, So Dakota, Nebraska, Kansas

Division No. 6. Headquarters: Fort Worth, Tex.
Includes Arkansas, Louisiana, Texas, Oklahoma

Division No. 7. Headquarters: San Francisco, Calif.
Includes Nevada, Arizona, California, Hawaii.

Division No. 8. Headquarters: Seattle, Wash.
Includes Montana, Idaho, Washington, Oregon, Alaska

Division No. 9. Headquarters: Denver, Colo.
Includes Wyoming, Colorado, Utah, New Mexico

The Commissioners of the three bureaus of FWA are: Publ Roads Administration, Thomas A. MacDonald; Public Buildin Administration, W. E. Reynolds; Bureau of Community Facilitie George H. Field. Mr. MacDonald is an honorary member of th American Society of Civil Engineers and the other two commi sioners are members. The Administrator and his staff of FW remain unchanged. Maj. Gen. Philip B. Fleming is Administrato Baird Snyder, Assistant Administrator; Alan Johnstone, Gener Counsel; E. E. Hall, Executive Officer; and Colonel Wm. M Carey, Chief Engineer. General Fleming and Colonel Carey a Members, Am. Soc. C.E.

Two Great Engineers

AN INTERESTING incident bearing on the indebtedness of Ge George W. Goethals, M. Am. Soc. C.E., as head of the Panam Canal construction to his predecessor John F. Stevens, Hon. M Am. Soc. C.E., is recounted in the September 1943 *Oregon Hi torical Quarterly*. In it William H. Galvani, an engineer of lo standing in Portland, speaks of meeting General Goethals the at a reception in 1922, and hearing him repeatedly introduced t guests as the "Genius of the Panama Canal." In the words o Dr. Galvani:

"This, the moment we were left to ourselves, brought up th subject of the Panama Canal, President Roosevelt, and John F Stevens, to whom he referred as his 'great predecessor,' and I a to a one-time chief of mine. And here, to my great surpris General Goethals made this astonishing statement to me:

" 'Do you know that there is nothing so annoying to me as th statement so generally made in my presence that I am the 'Geni of the Panama Canal'—I do not like it. Frankly, it is a fact tha Mr. Stevens devised, designed, and made provisions for pra tically every contingency connected with the construction an subsequent operation of the stupendous project, and, when h turned over the office of Chief Engineer to me, everything was i the very best working order or ready for the successful prosecuti of the work—my effort was to see that the project, as conceive designed, laid out, and duly recorded, was carried out accordingly submit required reports, approve expenditures, fill vacancie It is therefore to him, much more than to me, that justly belon the honor of being the actual 'Genius of the Panama Canal'—g not me.' "

Other references to this same appreciation of Stevens are men tioned in the article. Thanks are due to R. H. Corey, M. Am Soc. C.E., for calling attention to these reminiscences.

Reading List Issued by E.C.P.D.

A "READING List for Junior Engineers" has been issued by the Junior Committee on Professional Training of the Engineers' Council for Professional Development. The List, which is printed here, is a revision of the original 1936 list. It covers natural science, philosophy (including religion), economics and sociology, psychology, business and industrial management, literature (including poetry, essays and fiction), history, biography, travel, and the fine arts.

The Committee has striven to eliminate textbooks, encyclopedic works, and volumes difficult to obtain. Modern "best sellers" have also been eliminated, but each year the Committee plans to include, in mimeographed form, an addition to the printed listing, with five current best sellers. After five years on the addenda, a book will be eligible for transfer to the master reading list or for elimination and discard.

In preparation of the list, the "guiding of the young engineer to proper and competent sources of cultural and intellectual fields outside of the specific profession" has been foremost in the minds of the Committee. It is felt that "each selection answers admirably the main purpose of the list, namely, to serve as an introduction to vast territories of human achievement and to interest the junior engineer in fields that may be explored with attendant cultural profit." It has been assumed that most engineers will know the great and familiar works of literature and religion, such as Shakespeare's plays, Milton's poems, the Bible, and the novels of such authors as Dickens, Stevenson, and Mark Twain.

Additional copies of the "Reading List for Junior Engineers" may be obtained by addressing the Engineers' Council for Professional Development, 29 West 39th St., New York 18, N.Y. Price, 10 cents each, or 5 cents each in lots of 50 or more. (In Canada, direct inquiries to the Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2.)

NATURAL SCIENCE

CARREL, ALEXIS. Man the Unknown. Harper, 1935.
Presents a synthesis of what psychologists, biologists, chemists, and physicists have learned about the nature of man, and then goes on to show how a stronger healthier race may be developed.

CLENDENING, LOGAN. The Human Body. Knopf, 1937.
Unusually interesting book on the intricacies of the human body for the adult reader. To be read for an intelligent understanding of one's body and the mechanisms that make it go.

DAMPIER-WETHAM, W. C. History of Science and Its Relation to Philosophy and Religion. Macmillan, 1929.
Evolution of scientific thought and research from dawn of history in Babylonia and Egypt, through the speculations of Greece, and past the blind alleys of the Middle Ages to the present.

DARWIN, C. G. Origin of Species. London, J. Murray, 1859.
The preservation of favored races in the struggle for life.

DE KRUIF, PAUL. Microbe Hunters. Harcourt, Brace, 1926.
Biographical sketches of scientists and their work in the field of bacteriology and microscopy. Accurate yet adventuresome style.

EDDINGTON, A. S. The Nature of the Physical World. Macmillan, 1928.
Takes up both relativity and the quantum theory and traces the effect of modern concepts on Free Will and Determinism.

EINSTEIN, A. AND INFIELD, L. The Evolution of Physics. Simon and Schuster, 1938.
Seeks to deal with the great revolution of this century's interpretation of the realities behind physical events. It is an attack on a position of enormous difficulty and has been conducted with remarkable and at times brilliant clarity.

HALDANE, J. B. S. Adventures of a Biologist. Harper, 1940.
The author tackles in this book some of the unsolved problems of science and human destiny. It is compounded from his broadcasts, lectures, and essays over the previous seven years.

HOGBEN, LANCELOT. Mathematics for the Millions. Norton, 1937.
This book is written to popularize mathematics. It stresses the historical and social aspects. After chapters on the early history of mathematics, the author takes up arithmetic, geometry, trigonometry, calculus, etc., in their various phases and explains their nature and shows how they can be applied to life's problem.

HOGBEN, LANCELOT. Science for the Citizen. Knopf, 1938.
Explains the topics in six main themes. These are: the story of man's conquest of time-reckoning and earth-measurement, of material substitutes, of new power resources, of disease, of hunger, and behavior. Clocks, calendars, astronomy, geometry, navigation, and mechanics are discussed historically and technically.

KAPPE, BERNARD. Men of Science in America. Simon and Schuster, 1944.
Presents a broad picture of the growth of science in the U.S., told in the lives of America's great scientists themselves. It covers virtually every field of science in which Americans have played a major part during the past three and a half centuries. Among the scientists discussed are W. T. G. Morton (anesthetist); M. F. Maury (hydrographer), E. O. Lawrence (nuclear physicist), L. F. R. Agassiz (biologist), Benjamin Franklin, Joseph Henry S. F. B. Morse, and others.

KASNER AND NEWMAN. Mathematics and the Imagination. Simon and Schuster, 1940.
A book of popularization in which the authors reveal some of the tricks, some of the flights of fancy, the fascinations of higher mathematics.

MENNINGER, KARL. The Human Mind. Knopf, 1937; Garden City.

ZINSSER, HANS. Rats, Lice, and History. Little Brown, 1935.
This is the biography of typhus, a disease known since 1490 during the civil wars in Spain. In his discursive opening chapters, Dr. Zinsser takes up the relationship between science and art, then the history and changing nature of infectious diseases and epidemics in general. Of the fourfold relationship of louse, rat, man, and typhus, the life history and character of the louse are first discussed.

PHILOSOPHY

BROWNE, LEWIS. This Believing World. Macmillan, 1930.
A fascinating account of the development of the chief modern religions.

CABOT, R. C. Meaning of Right and Wrong. Macmillan, 1933.
A popularly written volume in which a professor of social ethics at Harvard sets forth the fundamental principles of ethics as they apply to the needs of modern life. He finds the main basis of right to be fidelity to agreements with one's self and others; the chief wrong, self-deceit.

DAY, CLARENCE. God and My Father. Knopf, 1932.
The portrait of a hot-tempered and masterful father by an unusually outspoken son. The author tells of his father's fearless relations with his God, his impatient endurance of his pastors, and the conflict of his high-spirited views with the faith of his wife.

DIMNET. Art of Thinking. London, J. Cape, 1929.
The purpose of this book is to convince men and women who are neither morons nor geniuses that they can nevertheless have a vigorous and interesting mental life of their own, a life that is more than the mere parroting of current snibboleths, which has become the popular substitute for thought. He convinces us that we can ourselves become the masters of the art of thinking by pointing out those rare intervals in our own mental experience when our insight has been the clearest.

DURANT, WILLIAM J. The Story of Philosophy. Garden City, 1933.
The essential thought of the great philosophers from Plato to John Dewey is readably and humanly presented.

EDDINGTON, A. S. The Expanding Universe. Macmillan 1933.

EMERSON, RALPH WALDO. Selected Writings of Ralph Waldo Emerson. Modern Library. Teacher and philosopher who influenced the American mind in the nineteenth century.

HOCKING, W. E. Types of Philosophy. Scribner, 1929.
A study in which the history of philosophy and its leading problems are combined through an analysis of the various types of philosophy. It is a text intended primarily for beginners in philosophical study.

LINK, HENRY C. Return to Religion. Macmillan, 1936.
A psychologist's account of his own conversion through the experiences he encountered in advising some 4,000 individuals over a period of 15 years in their problems of personality, happiness, love, marriage, and general living.

LIN, YU-T'ANG. My Country and My People. Reynal & Hitchcock, 1935.

LIPPMANN, WALTER. A Preface to Morals. Macmillan, 1929.
A book setting forth the belief that what is required for successful conduct in modern society is objectivity and loyalty to reality rather than to persons and desires, and contending that both intuition and scientific knowledge go to prove that virtue is the means to happiness.

ROBINSON, JAMES H. The Mind in the Making. Harper, 1931.

ROBINSON, JAMES H. The Human Comedy. Harper, 1937.

SPINOZA, BARUCH OR BENEDICT. Treatise on Religious and Political Philosophy. 1670; Ethics. 1675.
Spinoza's belief—the distinction between things of the spirit and material things is but superficial. There is one elemental substance, and that is infinite, depends upon nothing, and nothing depends on it. It is the cause of all, even of itself. To man God is known as thinking an extended substance. What is real in the individual is God. There is no free will for the human being.

ECONOMICS AND SOCIOLOGY

ARNOLD, THURMAN W. Folklore of Capitalism. Yale University Press, 1937.
Presents ideas about social organizations, which are not regarded as folklore, but accepted as fundamental principles of law and economics.

BURLINGAME, ROGER. March of the Iron Men. Scribner, 1938.
A social history of union through invention. The influence of inventions and technology on our democratic institutions through 1865.

BURLINGAME, ROGER. Engines of Democracy. Scribner, 1940.
Continuing "March of the Iron Men."

CHASE, STUART. The Tyranny of Words. Harcourt, Brace, 1938.
A book on thinking and logic, in which the author explores the field of semantics and applies his proposed discipline of language to such modern terms as "New Deal," "idealism," "liberty," "Fascism," etc.

CHILDS, MARQUIS. Sweden; the Middle Way. Yale University Press, 1936.
An exposition of the cooperative movement in Sweden, as it affects production, distribution, and consumption.

CHURCHILL, WINSTON. The World Crisis. 1923–1929.

COLE, G. D. H. Guide Through World Chaos. Knopf, 1932.
The main part of the book is a discussion of the causes, both immediate and underlying, of the world economic depression. Mr. Cole shows that as the crisis is world-wide, so the remedies must be world-wide. An Englishman, he writes from the standpoint of a citizen of the world.

DANIELS, JONATHAN. A Southerner Discovers the South. Macmillan, 1938.
Mr. Daniels throws light upon many questions, presenting perhaps the best available summary of Southern problems as they stand today.

FLANDERS, RALPH F. Taming Our Machines. R. R. Smith, 1931.
Attainment of human values in a mechanized society. Written in a popular manner in simple style. A fresh view of the world's present troubles.

LYND, R. S., AND LYND, H. M. Middletown in Transition. Harcourt, Brace, 1937.
Presents a record of forty years of change as a sequel to the authors' earlier book, "Middletown," which was "a study in contemporary American culture."

MARX, KARL. Capital. Charles Kerr, 1907–1908.
A critique of political economy. Written originally to make plain the fallacy of capitalistic economy, and still held to be the source from which anti-capitalistic movements draw their constructive power.

MANN, THOMAS. I Believe.

MARTIN, EVERETT D. The Meaning of a Liberal Education. Norton, 1926.
The author employs the useful device of describing what a liberal education is by contrasting it with what it is not. He writes mainly of the difference in propaganda and education and claims the educator and the propagandist have nothing in common.

THOREAU, HENRY D. The Heart of Thoreau's Journals, ed. Odell Shepard; Houghton, Mifflin, 1927.
Walden; or Life in the Woods.
It is the handbook of an economy that endeavors to refute Adam Smith and transform the round of daily life into something nobler than a mean gospel of plus and minus.

PSYCHOLOGY

CRANE, G. W. Psychology Applied. Northwestern University Press. 1932.

OVERSTREET, H. A. Influencing Human Behavior. People's Institute, 1925.
How to harness psychology to the task of achieving success is the theme of the book. The author puts the purpose of it into such sentences as "Life is many things, but at the center of it all is this. It is the process of getting ourselves believed in and accepted." How to achieve that end in whatever way and for whatever purpose is what he sets forth basing all his principles, arguments, and methods on the findings of psychology.

POWYS, J. C. Meaning of Culture. N. Y. Norton, 1929.
Culture is defined and placed in relationship to philosophy, religion, and the art of human relations.

SMITH, ELLIOTT DUNLAP. Psychology for Executives. Harper, 1934.
Deals with themes such as habits and how to handle them, personality, self-control, and the effect of group psychology in industry.

TRATTNER, E. R. Architects of Ideas. Carrick, Evans, 1938.
The purpose of this book is to justify the author's admiration for fifteen of the greatest theorists who have an impressive contemporary implication and to do away with his reader's vagueness as to just what each one of them stands for in the gallery of human eminence.

VEBLEN, THORSTEIN B. The Theory of the Leisure Class. Viking, 1912.
An economic study of institutions, based on the simple thesis that the present middle-class society does not produce and consume wisely or with any sense of proportion.

VITELES, MORRIS. Science at Work. Norton, 1934.
The application of sound principles of psychology in the field of industrial relations.

BUSINESS AND INDUSTRIAL MANAGEMENT

DENNISON, HENRY. Organization Engineering, McGraw-Hill, 1931.
Well written and shows original observations and analysis. Presents an over-all picture of the whole problem rather than a discussion of specific situations. The intent of the volume is to encourage further development of the art and science of organization.

HARDING, C. F. Business Administration for Engineers, McGraw-Hill, 1937.
Sets forth in the engineer's language the organization, economic, and managerial problems of the industries and public utility corporations with which he is likely to be associated. Outlines an avenue of executive advancement for the engineer.

WALTON, A. Do You Want to Be a Foreman? McGraw-Hill, 1941.
A readable analysis of foremanship, to give prospective foremen a sound idea of what being a foreman means—then to help them set their mind to it and fit themselves both in temperament and ability for the responsibilities that will come to them as foremen.

LITERATURE, INCLUDING POETRY, ESSAYS, AND FICTION

ADLER, MORTIMER J. How to Read a Book. Simon and Schuster, 1940.
The first section discusses reading in relation to learning and thinking, whether in school or out. The second part, the meat of the book, tells us how and what to read. The third part, called The Rest of the Reader's Life, deals with the basic reasons for literacy. It discusses the obligations of the citizens of a democracy and expounds the thesis that free minds make free men.

AUSLANDER, J., AND HILL, F. E. The Winged Horse. Doubleday Page, 1930.
Fluently written, not too pedantic narrative of the course of English poetry, beginning with Chaucer down to Stephen Vincent Benet and Leonil Adams. The co-authors are men sensitive to poetic beauty, appreciative of the poets' task, and convinced of the comforting and enabling functions of truly great poetry.

BALZAC, HONORE DE. Pere Goriot. Paris, Charpentier, 1846; N.Y., Burt, 1886.
A comedy.

BENET, STEPHEN VINCENT. John Brown's Body. Farrar & Rinehart, 1928.
A book-length epic poem of the Civil War. The author conveys with fine fervor the sense of doomed and twisted destiny which overshadows the Civil War or war between the states. He grasps in powerful hands the violent contrast between the America of Lee and John Brown and that of "the great metallic beast expanding West and East" that is the America of today.

BUCK, PEARL. The Good Earth. Reynal & Hitchcock, 1931.

BUTLER, SAMUEL. The Way of All Flesh. Macmillan, 1903.
The hero is reared in an ecclesiastical environment against which he rebels. The book is an attack upon the Victorian pattern of family life.

CHAUCER, GEOFFREY. Canterbury Tales. Westminster, England, Caxton, 1484.
Truth ballads of good counsel.

CONRAD, JOSEPH. Lord Jim. Modern Library, 1931; Doubleday and Page, 1916, 1923; McClure-Phillips, 1903.
A romance of the sea.

DAY, CLARENCE. This Simian World. Knopf, 1920.
Ours is a Simian civilization. If we had not descended from the monkey, what would our world be like from the point of view of exterrestrial beings?

DICKENS, CHARLES. David Copperfield. Maxmillan, 1849–1850.
The personal history, adventures, experiences, and observations of David Copperfield, the youngster of Blunderston Rookery.

DOSTOYEVSKY, FEODOR. Brothers Karamazov. Modern Library, 1943.
This is considered one of the great productions of the world. It tells the story of Old Karamazov (Russian) and his three sons.

FROST, ROBERT. Collected Poems. Holt, 1939.
Presents six of the author's books: (1) A Boy's Will; (2) North of Boston; (3) Mountains' Interval; (4) New Hampshire; (5) West-Running Brook; and (6) A Farther Range.

FURNAS, C. C. The Next One Hundred Years. Reynal & Hitchcock, 1936.

GALSWORTHY, JOHN. Forsyte Saga. Scribner, 1922.

HILTON, JAMES. Good Bye, Mr. Chips. Little, Brown, 1934.

IBSEN, HENRIK. An Enemy of the People; The Wild Duck. Modern.

JOWETT, BENJAMIN. Plato—The Republic. Clarendon Press, 1902 and Modern Library.
A demonstration of justice by picturing an ideal state.

KIPLING. Kipling Pageant. Doubleday, Doran, 1935.
Short stories and chapters from some of Kipling's books, and ninety pages of verse. Here are such immortalities as "The Man Who Would Be King," "Without Benefit of Clergy," "Brugglesmith," "Wireless," and "The Brushwood Boy."

MELVILLE, HERMAN. Moby Dick.

MONTAIGNE, M. E. Essays. London, Becker, 1943.
These essays, tolerant in spirit, familiar and easy in style, set forth the author's philosophy, epitomized in his phrase "Que-sais-Je?" and with a wealth of detail, draw a picture of the man himself.

PALGRAVE, F. T. The Golden Treasury.

SAINT EXUPERY, ANTOINE. Wind, Sand and Stars. Reynal & Hitchcock, 1939.

SHAKESPEARE, WILLIAM. Plays and Sonnets. G. Routledge, 1852.
Presents a collection of the works of Shakespeare, one of the world's greatest poets and dramatists.

STEINBECK, JOHN. Grapes of Wrath. Sun Dial, 1941; Modern Library Edition, 1941.
A story of agricultural migrants to California.

UNTERMEYER, LOUIS. Modern American Poetry. Harcourt, Brace, 1942.
One of the best anthologies of American poetry.

VAN DOREN, MARK. American Poets. Little, Brown, 1932.
Selections from 57 poets from 1630 to 1930.

WHARTON, EDITH. Ethan Frome. 1911. Scribner, 1938.
A short tragedy of the Massachusetts hills.

WHITMAN, WALT. Leaves of Grass.

WOLFE, T. Of Time and the River. Sun Dial Press, 1935.
Presents a magnificent epic of American life, and where the life of North Carolina is dominant the novel is at its best.

HISTORY

BEARD, C. A., AND BEARD, MRS. M. Rise of American Civilization. Macmillan, 1930.
A delightful history giving a true picture of past events and an appreciation of our great American heritage. Social, economic, and political history and interpretation.

BROOKS, VAN WYCK. The Flowering of New England. Merrymount Press, 1941.
Presents a study of the New England as it has found expression in the lives and works of writers.

CHASE, STUART. Rich Land, Poor Land. Whittlesey House (McGraw-Hill), 1936.
A study of America—a vast and luxurious continent—before the coming of the white man, compared with the forests, water erosion, destruction by water pollution, toll of mineral and power exploitation of today and the implications that may be drawn from this, with respect to the need for a national plan of conservation, social and economic considerations, and our responsibility to future generations.

CHURCHILL, WINSTON. The Eastern Front. 1931.

LASKI, HAROLD J. The American Presidency. Harper, 1940.
A scholarly analysis and interpretation of the supreme political office in the U.S. by an Englishman privileged to observe its workings from near at hand and with the benefit of criticism of American friends. A penetrating study and a keen estimate of the Presidency, indicating the traditions, conventions, and laws in their relationship to the Cabinet and the Congress, and the people themselves.

MORISON, SAMUEL E., AND COMMANDER, HENRY S. The Growth of the American Republic. Oxford, 1939.
A general survey of United States history.

MUMFORD, LEWIS. The Culture of Cities. Harcourt, Brace, 1938.
A survey of the history of cities from medieval times to the present with proposals for the betterment of the city of today and tomorrow.

TOLSTOI, L. N. War and Peace. Heritage Press, 1943.
A prose epic of the Napoleonic wars in which are reflected the psychology, philosophy, and inner aspirations toward the self-release of the Russian people.

WELLS, H. G. Outline of History (new and revised). Garden City Publishing Co., 1931.
A readable commentary on the life of man from the time of the stone age.

BIOGRAPHY AND TRAVEL

BEVERIDGE, ALBERT J. The Life of John Marshall. Houghton, Mifflin, 1916–1919; republished 1929.
The constitutional opinions of John Marshall grew out of serious public conditions, national in extent. The effort is made to relate the circumstances that required him to give to the country these marvelous state papers. In order to understand the full meaning of his deliverances and to estimate the just value of his labors, it is necessary to know the historical sources of his foremost expositions of the constitution. In these volumes a history of the times of John Marshall is presented.

LLINI, BENVENUTO. Autobiography. Pocket Books, 1940.
Cellini lived from 1500–1571. He was an Italian sculptor, metal worker, and author. This story reveals one of the most spectacular and singular careers in the history of art.
URCHILL, WINSTON. My Early Life; 1930.
Thoughts and Adventures, 1932.
RIE, EVE. Madame Curie. Doubleday, 1937. The life story of the co-discoverer of radium, written by her younger daughter. This biography is fascinating as a record of scientific research.
NA, R. H. Two Years Before the Mast. Macmillan, 1933.
The author shipped as a common sailor around Cape Horn to California. The narrative of this voyage is an American classic of the sea and is a vivid account of a sailor's life in the great days of American sailing.
REMAN, DOUGLAS. Robert E. Lee: A Biography. Scribner, 1934–1935.
The leader of the Confererate Army.
WRENCE, T. E. The Seven Pillars of Wisdom. Viking, 1926.
The story of the author's political and military adventures in Arabia.
UTARCH. Lives. Cork University Press, 1937.
Forty-six historical biographies arranged in pairs, the life of a Greek being followed by the life of a Roman. A classic of biographic style.
MPANSON, VILHJALMUR. Northward Course of Empire. Macmillan.
The author because of his sound understanding of our new Arctic frontiers has been one of the first to realize the possibilities of this Northward Empire. He has written of it in a serious mood and wishes it to be taken seriously by thoughtful minds.
FFENS, LINCOLN. Autobiography. Harcourt, Brace, 1931.
The life story of an American reporter, journalist, student of ethics and politics, a muckraker in the days of the early 20th century. Attempts to reform government. He was a friend of city bosses, foreign dictators, youthful radicals, and disillusioned, loving optimists.
LLERY-RADOT. The Life of Pasteur. Garden City, 1937.
NER, HANS. As I Remember Him. Little, Brown, 1940.
Biography of a physician, one R. S., reputed to be a friend of the author, but probably the author himself. R. S. was born of German parents somewhere in Westchester. The book is the story of his growth from babyhood to manhood, his school days, his choice of medicine as a profession, and his work as an interne in the slum district of New York in the 1900's. His later career as a bacteriologist in Siberia, Russia, Egypt, Mexico, and the Orient is traced.

ART

LLEY, M. H. Simple Guide to Pictures and Painting. Dutton, 1928.
Deals with principles of construction—design, personality, craft, tradition, and the ways in which a painter works. Outlines the development of painting from Byzantine to modern French.
ENEY, SHELDON, AND CHENEY, MARTHA. Art and the Machine. McGraw-Hill, 1936.
An account of industrial design in 20th century America.
ENEY, SHELDON. A World History of Art. Viking, 1937.
History of art in all its phases from its earliest beginnings to the present. Mr. Cheney has de-emphasized history as such and has attempted rather to stress the qualities of greatness in the outstanding works of art throughout history.
ATEN, THOMAS. Men of Art. Simon & Schuster, 1931.
Includes not only an outline of art, a history of painting and sculpture but the author makes living figures of his "Men of Art" working against the background of their times.
PEN, SIR WILLIAM. Outline of Art. Putnam, 1923.
Two large volumes describing briefly the works of artists from ancient to modern times. Easily read and profusely illustrated, hence can be skimmed through or absorbed at leisure.

GENERAL

OWLER, HENRY W. Concise Oxford Dictionary of Current English. Oxford University Press, 1926.
A large amount of information in very little space.

Washington Award Goes to Arthur H. Compton

THIS year's recipient of the Washington Award—Arthur H. Compton, dean of the division of physical sciences and chairman of the department of physics at the University of Chicago—was honored at a dinner given in Chicago on February 21. The dinner was sponsored by the Western Society of Engineers, and the attendance included representatives of the leading engineering societies.

Founded in 1916 by John W. Alvord of Chicago, the Washington Award is administered by the Western Society of Engineers on the recommendation of a commission representing the Four Founder Societies and the Western Society of Engineers. Previous recipients include Herbert Hoover, Orville Wright, Michael Pupin, Ralph Modjeski, and Ralph Budd.

A native of Ohio, Dean Compton was educated at Wooster College (Ohio) and Princeton and Cambridge universities. He was professor of physics at the University of Chicago from 1923 to 1940, and since the latter year has been dean of the division of physical sciences. He is also consulting physicist to the General Electric Company and the author of many works on X-rays and allied subjects. In 1927 he was awarded the Nobel Prize in Physics for his discovery of the total reflection of X-rays and the change of wavelength of scattered X-rays.

The citation accompanying the present award reads: "for his research and teaching in the physical sciences increasing man's knowledge of the action of X-ray and cosmic-rays."

Howard Peckworth Leaves Staff for Chicago Post

THE FIRST of April will find Howard F. Peckworth on his way to a challenging new position as Managing Director of the American Concrete Pipe Association. Mr. Peckworth, who has served the Society for three years as Assistant to the Secretary, and before that for another year as Editor of CIVIL ENGINEERING, has made many friends in the Society during the course of his work.

HOWARD F. PECKWORTH

Although his assignments included practically all aspects of the Society's service to the profession, Mr. Peckworth is probably best known for his work with the Committee on Employment Conditions. In this function he has visited many of the Local Sections, assisting them to find a solution for their employment problems. His years of experience on construction work were of great assistance to him in understanding the relative insecurity of such engagements.

Headquarters for Mr. Peckworth's organizational activities will be in Chicago. Mr. Peckworth's Assistant Managing Director will be Theodore J. Kauer, M. Am. Soc. C.E., who will have charge of the Washington office of the Association.

A Live Local Section Publication Keeps Members Interested

IT IS hardly fair to single out from the many publications of Local Sections any one for special recognition. But perhaps it is permissible to comment on one feature of *The Texas Engineer*, monthly publication of the Texas Section of the Society. Its list of personal items is remarkable for volume, variety, and interest.

An example is the recent February number, consisting of a 16-page (plus covers) pamphlet. Of these pages, 9 cover matters of interest regarding members of the Section, their wives and families, plus some professional subjects involving personal items, briefly covered.

In explanation of this fine showing it might be mentioned that conditions in Texas vary considerably from those in other Sections. The membership is large—over 900 members—and these are scattered over a large area. Then again, five coordinate subsections have been formed. These, scattered throughout the area, are comparable to independent Local Sections in themselves. In fact, some of the subsections have larger membership than some Local Sections. Then, too, a number of the Sections have what are known as Wives' Clubs, which meet in the afternoon for sociability or philanthropic work, and sometimes in the evening for a mixed gathering.

But with all these conditions considered, it nevertheless remains a fact that the news notes of *The Texas Engineer* are an achievement of note. For this, Secretary-Treasurer John A. Focht deserves great credit. Or perhaps it is the ten associate editors that deserve the commendation. Significantly enough, nine of these are wives of Texas members.

Connecticut Section Promotes Accuracy of Maps

State Groups Cooperate in Preparing Code of Recommended Practice for Standards

IN JANUARY 1943, a registered professional engineer and land surveyor in Connecticut reported a case to the State Board of Registration for Professional Engineers and Land Surveyors in which a preliminary topographical map, not so marked but certified by a registrant, was used for accurate earthwork computations. Errors from the use of this map were very costly. The Board presented the problem to the Connecticut Technical Council, Inc., an organization composed of delegates from practically all the engineering societies in the state, and requested suggestions as to the solution.

EFFORTS ARE COMBINED

The Technical Council referred the matter to the Connecticut Section of the American Society of Civil Engineers and the Connecticut Society of Civil Engineers, with a request that they appoint committees to study and report on the feasibility of methods by which the accuracy of all maps may be indicated. The two committees later consolidated into one, to which a representative of the Connecticut Society of Professional Engineers was added. The State Board also appointed a Committee which collaborated in the preparation of the Code.

The Technical Council indicated to the Committee two possible procedures:

1. Legislative action
2. Adoption of a Code of Recommended Practice for Standards of Accuracy of Maps

The latter procedure was adopted with the belief that voluntary action along ethical lines was preferable to compulsion which would result from legislative action.

The Committee made an extended study of various suggested forms of a code, consulted with engineers in the utility, municipal and educational fields, as well as those in private practice, before presenting the code for final approvals. The Connecticut Section and the Connecticut Society approved the Code before it was submitted to the Technical Council. After favorable action by the latter, the State Board approved it and voted to mail copies to all registrants holding combined Professional Engineer and Land Surveyor, and Land Surveyor certificates, and to all town clerks within the state. The Board also is sending copies to all registration boards in other states and many leading engineering schools to give the profession in other sections of the country an opportunity to benefit from the exhaustive study of this problem made in Connecticut.

BROAD PURPOSES OUTLINED

The Code covers maps and plans which may become public land records, be used as court evidence, or represent data acquired, assembled, or calculated for a client by a land surveyor. If properly established and followed, these standards will be decidedly helpful, not only to the map maker and his clients, but also to those who may in the future use such maps.

The general purpose of the Code is to present uniform methods and procedures by which maps may be classified and identified according to specified degrees of accuracy. It also will place limitations on maps for purposes not anticipated by the surveyor when the survey was made. Use of code classifications will tend to reduce or prevent unfair competition. It also will permit the surveyor to present standards which are considered as meeting the requirements of his client.

In establishing classifications, consideration was given to the equipment and methods in relation to the type of project, the available funds, and the purpose for which the map is required. No complete description of surveying techniques is given in the Code, nor can definite information be given as to the methods of determining the classification for a particular project. Experience must be acquired to select the proper classification and assure the necessary checks and refinements consistent with the specified accuracy.

The Committee includes a foreword describing the Code and making recommendations as to its use. The various classifications of maps and corresponding control employed are given in the following list:

Class AA. Precise Transit Surveys
Highest degree of Accuracy
Class A-1. Transit Surveys
Location, property and development surveys with high degree of accuracy
Class A-2. Transit Surveys
Location, property and development surveys of reasonable accuracy
Class A-3. Transit Surveys
Stadia surveys
Class B. Reconnaissance Surveys
Class C. Aerial Reconnaissance Surveys
Class D. Compilations
Class E. Sketches

Each classification includes descriptive matter on the particular type of survey and map, recommendations as to instruments used and procedure to obtain the desired results, as well as ratios and formulas. The following is an example of one of the classifications:

CLASS A-1. TRANSIT SURVEYS

Purpose

To present data with a high degree of accuracy in

a. Maps showing location, property and development surveys of the better type, carefully executed with equipment in proper adjustment and with proper attention to the reduction of errors.

b. Maps involving smaller areas than those of Class AA with an accuracy lower than that of Class AA.

Instruments and Equipment Used

Transit or plane table with telescopic alidade
Telescopic level
Steel tape
Thermometer

Procedure

Base maps on closed and adjusted traverses and show only accurately measured lengths and directions or computed lengths and directions based on the closed traverse.

Use a transit or plane table with telescopic alidade with suitable control in locating details or sketching contours.

Use points established by tape traverse for horizontal control.

Use bench marks established by telescopic level for vertical plane-table control if large area is involved.

Indicate deed references and deed dimensions on map although they may differ from the results of the survey.

Note on map data from a previous survey or from work by others, indicating if any of previous data have been checked or whether any differences have been discovered.

Note on map level datum used.

Survey Accuracy

Traverse

The position closure after distribution of azimuth error should not exceed 1:10,000.

Levels

Discrepancies between forward and backward runs should not exceed four one-hundredths feet times the square root of length of section in miles.

Map Accuracy

The limits of error in any map shall not exceed $^1/_{10}$ inch between points as scaled on the original map. Reproduction methods by wet process and so-called blue prints, and other copies may show greater overall errors due to distortion caused by moisture and therefore should not be scaled.

The elevation error shall not exceed one-half the contour interval.

A convenient check of contour accuracy is to run a test profile across a mapped area. Then plot this profile and compare it with a profile scaled from the map. At least 90% of the points tested should be correct within one-half the contour interval.

Under a heading "General Data," the Code makes certain recommendations with respect to methods of showing the direction of north, titles on maps, certification of code classification, and notations on maps.

The Code Committee has been appointed as a standing committee to review the Code from time to time and report to what extent it is being followed, whether or not it is effecting the desired results, and to recommend such changes as may be necessary to accomplish its purpose. If, after trial and possible modification, the Code is accepted by a majority of the engineers and land surveyors of Connecticut, but voluntary procedure does not prove completely effective, the Committee will recommend that Technical Council sponsor the necessary legislation to make it a law in the state.

Acknowledgment is made in the Code of the cooperation and service rendered to the profession by the Connecticut Section of the American Society of Civil Engineers and the Connecticut Society of Civil Engineers, Inc., for defraying the cost of printing the Code. Copies of the Code may be obtained by writing H. Jackson Tippet, 30 Westwood Road, New Haven, Conn. A nominal fee of 25 cents per copy should be sent with the request for copies, to cover printing and mailing costs.

The personnel of the Committee on Standards of Accuracy of Maps, of the Connecticut Technical Council, Inc., is as follows:

Jay H. F. Clark, *Chairman*	Charles A. Cahn
Henry W. Buck, *Vice-Chairman*	A. S. Lynch
Charles W. Cooke, *Vice-Chairman*	Theodore F. Neuhaus
Roger C. Brown	Frederick P. Stabell

Six of the eight members of the Committee are members of the Connecticut Section of the American Society of Civil Engineers. The Committee of the State Board consisted of:

James A. McElroy	W. K. Simpson,
L. Norman Germain	*Secretary of Board*

(We are indebted to Chairman Clark for this résumé covering this instructive activity of the Connecticut Section. From it other Local Sections may receive inspiration for similar accomplishments in their own localities.)

D. P. Barnes, Former Staff Member, Awarded Bronze Star Medal

ANNOUNCEMENT has been made of the award of the Bronze Star Medal to Lt. Col. Donald P. Barnes, former editor of CIVIL ENGINEERING, "for his outstanding work in supervising the camouflage and maintenance operations on airfields constructed by the IX Engineer Command in France and Belgium." The decoration covers his services as commanding officer of an aviation engineer camouflage battalion and an airfield maintenance unit during the period from March 30 to December 31, 1944.

DONALD P. BARNES

During the first part of this period Colonel Barnes was in charge of training engineer and air-force personnel in camouflage technique. Later, during the early months of the invasion in France, he directed the camouflage work on airdromes and assumed the additional command of the maintenance unit.

The citation accompanying his award reads, "His careful planning, superior technical knowledge, and untiring personal endeavors have been an inspiration to his superiors and subordinates alike and reflect great credit upon himself and the armed forces."

A graduate of Oregon State College and California Institute of Technology, Colonel Barnes was with the U.S. Bureau of Reclamation from 1934 to 1940, his last assignment for the Bureau having been at the California Institute of Technology. He became editor of CIVIL ENGINEERING in September 1940 and resigned in April 1941 to enter the Corps of Engineers, U.S. Army, with the rank of major. Colonel Barnes joined the Society as a Junior in 1930, transferring to Associate Member in 1936. In 1932 and 1933 he studied abroad as Freeman Traveling Fellow for the Society.

The Engineer in Foreign Service

XII. To China by Air

Excerpts from a Letter dated January 30, 1945, from Headquarters, India-Burma Air Service Command

By S. C. GODFREY, M. AM. SOC. C.E.
BRIGADIER GENERAL, CORPS OF ENGINEERS, U.S.A., AIR ENGINEER

THOUGH China now constitutes a separate theater, I welcome the occasional calls that still come to go there—and am just back from an interesting trip. While I can't discuss the mission that took me there, I can tell of incidents along the way.

A good talk with Chennault, who, as *Time* says, has lost some of his bases but none of his sting. We inspected one airfield, which has a runway over two miles long—longest in Asia, one of the longest in the world. On the unofficial side, there was an Engineer party at the "Tennis Club," a sort of night club where a U.S. orchestra plays for dancing once a week, which is very popular.

On to Chungking, gray and chill as usual at this time of year. Here the new Theater Headquarters is having growing pains as Al Wedemeyer, now wearing his third star (our youngest lieutenant general), surrounds himself with new assistants. He asked me to stay at his house, and took me that first night to a cocktail party at the Navy's hostel (one Navy wife has managed to get to China); and to a buffet supper at the Press Hostel where a correspondent of AP and his wife were hosts to a cosmopolitan gathering that included French and Russians. Ambassador Patrick Hurley, who is living with Al until his own quarters are finished, was with us and in fine form.

You know of my association with and liking for Dr. Tseng Yung-Fu, the Generalissimo's Minister of Communications, dating back to our collaboration on the Super-Fortress airfields last winter. I was glad to drive out 20 miles to his country place on Sunday—a beautiful spot high above the Yangtse River. It was the birthday of his mother, and what a party! Brothers and sisters and aunts and uncles and cousins must have been there, with their children. For lunch we sat at a separate table, all men, mostly the assistant engineers whom I had met before. Other rooms in the house swarmed with the family visitors. At a Chinese home one frequently is entertained without meeting the ladies of the house. But I asked to meet Madame Tseng, and had a nice chat with her after lunch.

Wine had been circulated and many "Gombeys" drunk during lunch, but when I left the enormous birthday cakes with iced frostings and the fireworks were still untouched and awaiting what must have been a big family celebration!

That afternoon I called by appointment on Madame Sun Yat-Sen. I was charmed as usual by her wisdom and wit. She had received news from the Russian-German front later than anything I had (and isn't that news amazingly good!). Her bit of fun this time was at the expense of General Hurley—whose rendition of the call of his Oklahoma Indians at a formal Chinese dinner had brought the servants in running, thinking that someone was being murdered!

That evening a broadcast in commemoration of the opening of the Ledo-Burma Road was given by Generals Wedemeyer and Hurley and the Generalissimo—the latter stating that the Road should be named in honor of the American general whose recall he had recently been responsible for.

On the way back I stopped over in Northern Burma and had lunch with D. I. Sultan. He is in cheerful mood over the opening

of the Road. The Ledo Road has had a grand build-up, and is a tremendous engineering achievement. Far less publicity has been given to the remarkable accomplishments of supply by air—which has been the real life line of the troops in Burma.

The above has taken five days and involved about 3,000 miles of travel—the passage of the Hump is facilitated now by faster and more comfortable planes, following more direct and less hazardous routes.

Oh, Ye of Little Faith

IN HUMAN NATURE it is sometimes all too easy to loose faith. Yet nearly every engineeer has his favorite example which buoys him up when he would despair. Add a recent experience of the Headquarters staff.

Within a month two members paid in to the Society dues which had been duly forgiven by the Board of Direction years ago. There was a period in the early '30s when a good many of us found work and remuneration therefrom a bit difficult to obtain. It was during these same dark days that the Board recognized hardships and forgave the dues of many members.

It was never intended that there should be any obligation to pay these forgiven dues at a later date. Yet now, after ten years have passed and engineers that were hit by the depression again have one bill to rub up against another in the old billfold, two members have requested—no, insisted—that they be permitted to reassume their obligations. "I send this check simply because I have felt for some time that it was still an obligation that I would like to take care of," writes one.

Is a couple of hundred dollars the only gain to our Society? No indeed! The good will of two members thus demonstrated justifies the faith in "you and I and every other guy" that the Board evidenced by its action a decade ago.

Appointment of Society Representative

HAROLD E. WESSMAN, M. Am. Soc. C.E., has been appointed Society Representative on the Research Procedure Committee of Engineering Foundation.

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Dinner meeting in the Cleveland Engineering Societies Building, on April 20, at 6:30 p.m.

CINCINNATI SECTION—Meeting in the Cincinnati Engineering Societies Headquarters on April 20, at 8 p.m.

COLORADO SECTION—Dinner meeting at the Oxford Hotel on April 9, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on April 16, at 12:15 p.m.

FLORIDA SECTION—Dinner and inspection trip on April 6—inspection of mineral mine, operated by Rutile Company of Florida, at 6 p.m.; dinner at Seminole Hotel at 8 p.m.

GEORGIA SECTION—Luncheon meeting at Davison's Tea Room on April 6, at 12:45 p.m.

INDIANA SECTION—Meeting at Purdue University on April 19.

MARYLAND SECTION—Dinner meeting at the Engineers Club on April 26—cocktails at 6 p.m., dinner at 7 p.m., and meeting at 8 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on April 18, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Southern Tavern on April 5, at 7 p.m.

MOHAWK-HUDSON SECTION—Dinner meeting at Hale House, Union College, to acquaint the student members of Union College and Rensselaer Polytechnic Institute with some of the problems of the practicing engineer.

NORTHWESTERN SECTION—Dinner meeting at the Campus Club on April 2, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner and meeting at the Engineers Club on April 10—dinner at 6 p.m.; meeting at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Hotel Club every Tuesday at 12 m.

SAN FRANCISCO SECTION—Anniversary dinner meeting at the Engineers' Club on April 17, at 5:30 p.m. (Section organized April 28, 1905.)

SAN DIEGO SECTION—Dinner meeting at the U.S. Grant Hotel on April 26, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Regular dinner meeting of the Chattanooga Sub-Section, with the other Founder Societies, at the China Restaurant on April 10, at 6 p.m.; dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on April 11, at 6 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on May 7, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on April 19 at 12:15 p.m.

TRI-CITY SECTION—Dinner meeting at the Blackhawk Hotel on April 19, at 6:30 p.m.

Recent Activities

CENTRAL ILLINOIS SECTION

The Central Illinois Section held a special dinner meeting on January 22 to honor two of its members—Ralph B. Peck and Nathan M. Newmark—who are this year's recipients of the Norman Medal and the J. James R. Croes Medal, respectively. Following speeches of appreciation by Wilbur M. Wilson, Director of the Society and research professor of structural engineering at the University of Illinois, and Dr. Karl Terzaghi, two-time recipient of the Norman Medal Messrs. Newmark and Peck responded briefly. Dr. Arthur C. Willard, president of the University of Illinois, concluded the program with a talk on the relation between research and education in professional engineering.

CENTRAL OHIO SECTION

At the meeting held on January 25 the Section went on record as approving the recommendations of the Committee on State-Wide Coordinates. A talk on the subject of "Methods in Quantitative Ground-Water Investigations" comprised the technical program for the occasion. This was given by E. J. Schaefer, engineer in charge of ground-water investigations for the U.S. Geological Survey in Ohio. On February 22 the Section sponsored a joint meeting with the Franklin County Chapter of the Ohio Society of Professional Engineers for the purpose of discussing the place of the Committee for Economic Development in postwar planning. The principal speakers were Mark B. Owen, director of the Society's Committee on Postwar Construction, and C. F. Leland, regional manager of the fourth region of the Committee for Economic Development. Their talks were discussed by Delmar G. Starkey, executive secretary of the Columbus Chamber of Commerce, and Grover Clements, engineer for the Franklin County Planning Commission.

CLEVELAND SECTION

Various business matters were discussed at the annual meeting of the Section, which took place on January 12. The election of officers for the coming year resulted in the selection of Otto F. McConnell, for president; Ralph L. Harding, for vice-president and Arthur H. Stark, as secretary-treasurer. An extemporaneous talk on education—given by F. E. Ayer, dean of the engineering college at the University of Akron—comprised the technical program. Dean Ayer substituted at the last moment for the scheduled speaker, Elmer L. Lindseth, vice-president of the Cleveland Electric Illuminating Company, who was unable to be present. The technical program for the February dinner meeting consisted of talks by seven senior-class civil engineering students at the Case School of Applied Science—Donald Halperin, William Diemer, Daniel Dunner, Russell Bish, Morton Gross, George Garrett, and Robert Volk—who discussed topics of current engineering interest.

COLORADO SECTION

Speakers at the January meeting of the Section—held in Denver on the 8th—were Maj. W. J. Keller, of the U.S. Army Air Forces

Alfred J. Ryan, Denver consultant. Major Keller discussed construction of airports in the British Isles prior to D-Day, while Mr. Ryan gave an illustrated talk on the location of a north-south freeway through Denver On February 12 the group enjoyed a program of colored sound pictures from the General Electric Company, dealing with the new type radio wave for transmission known as "frequency modulation" Then Chaplain J. S. Cordill, lieutenant colonel, U. S. Army, spoke of his experiences in the African Theater of War.

GEORGIA SECTION

There was a good turn-out for the February luncheon meeting to hear Robert L. MacDougall, vice-president and general manager of the MacDougall Construction Company, Atlanta, discuss the new Grady Hospital Authority. The Authority, which is being established by Fulton and DeKalb counties, together with the city of Atlanta, will provide a management agency as well as a legally constituted body that can enter into contracts for the construction of the proposed $30,000,000 metropolitan hospital. An enthusiastic discussion followed from the floor.

HAWAII SECTION

On December 19 members of the Hawaii Section were guests of the Construction Service of the Central Pacific Base Command for dinner and a technical program. During the business meeting various committee reports were discussed, and new officers for 1945 were elected. These are Leslie J. Watson, president; Walter E. Samson, vice-president; and Ben E. Nutter, secretary-treasurer. The principal speaker was George E. Hatch, who gave a talk on foundation studies for the new Tripler General Hospital. The hospital, a nine-story structure located on a ridge, will be the largest building in Hawaii, and thus is of special interest to engineers. At the conclusion of the program, the members and guests were invited to inspect the testing laboratories.

ILLINOIS SECTION

"Chicago Plans for Its Future" was the topic of discussion at the February dinner meeting of the Section—a joint session with the Chicago Engineers Club, held on the 8th. This talk was given by Evert Kincaid, director of the Chicago Plan Commission, who outlined the program of public works now being formulated for the postwar period, with special emphasis on proposed housing developments in the Chicago area. Mr. Kincaid stated that the commission, in cooperation with the various city departments and other governmental agencies, has compiled a list of worth-while projects totaling almost a billion dollars. A number of women students and staff members from the Illinois Institute of Technology came in after dinner to hear Mr. Kincaid's talk.

INDIANA SECTION

At the meeting that took place on February 21, Dr. R. E. Fadum reported on the Local Sections Conference held in New York at the time of the Annual Meeting. The feature of the program was a talk on postwar construction by Mark B. Owen, director of the Society's Committee on Postwar Construction. Mr. Owen stressed the fact that Society members can be of definite assistance to the Committee on Economic Development and recommended that every engineer do his part to assist in developing the private construction program of the country. He was followed by C. R. White, regional manager of the seventh district of the Committee for Economic Development, who outlined the program of the Committee. In the ensuing discussion Mayor Tyndall, of Indianapolis, took an enthusiastic part.

INTERMOUNTAIN SECTION

The January meeting—held in Salt Lake City on the 18th—was devoted largely to a discussion of the Colorado River Mexican Treaty. A resolution expressing opposition to the treaty in its present form was unanimously adopted. At the luncheon meeting, held on February 23, the speaker was C. B. Breed, Director of the Society and professor of civil engineering at Massachusetts Institute of Technology. After giving a talk on recent activities of the Society, Professor Breed was greeted by many of his former students in the area.

KANSAS SECTION

During the annual business meeting, which took place in Topeka on February 2, the Kansas Section elected the following officers for the coming year: George S. Knapp, president; George W. Lamb, vice-president; and John W. Frazier, secretary-treasurer. A talk on the state building program comprised the technical program. This was given by Ray Stookey, Kansas state architect.

LOS ANGELES SECTION

The development of the diesel locomotive and its future in the railroad industry was the topic of discussion at the January meeting of the Los Angeles Section, the principal speakers being W. P. Hartman and Milton C. Blanchard. Both are on the engineering staff of the Atchison, Topeka and Santa Fe Railway Company. A technicolor motion picture, entitled "Loaded for War," supplemented the talks. This film, which was prepared by the public relations department of the railway company, dramatically illustrates the part that the railroads are playing in the transportation of supplies for the war effort. As principal speaker at the February meeting, Mortimer Kline gave an exceptionally interesting talk on "Our Foreign Oil Policy and the Anglo-American Oil Agreement."

MARYLAND SECTION

Engineering possibilities in Latin America were stressed by Maj. Gen. Julian E. Schley in a talk before the February dinner meeting of the Maryland Section. Unfortunately though, he pointed out, resistance has been built up against employment of our engineers. This is due largely to the fact that, in the past, American investors have gone into Latin-American countries with exploitation as a leading motive, and this has inspired unfavorable legislation against foreign capital. After the war the problem of the engineer there will be largely one of transportation, General Schley stated. In the United States the extension of our highways has broken down all barriers but, because of the rugged terrain, there are few good roads in Latin America. In consequence, air transportation has surpassed that on land in some parts. Following General Schley's talk, G. H. Pouder, executive vice-president of the Baltimore Chamber of Commerce, commented on Baltimore as a Latin-American port, stating that before the war there were sixty-four steamship lines operating between Baltimore and Latin America with over three hundred firms engaged in the export business. Circulars, describing the facilities of the port in Spanish and Portuguese, have been distributed in the neighboring countries to the south, and the port is expecting a big expansion of trade after the war. General Schley is Coordinator of Inter-American Affairs.

METROPOLITAN SECTION

"A symposium on the subject, "A Neighborhood Approach to City Planning," was presented at the February 21 meeting of the Section, the principal speaker being J. Davidson Stephen. Mr. Stephen, who has made an exhaustive study of a plan for the Detroit area and its suburban community of Plymouth, Mich., illustrated his talk with lantern slides. The discussion was led by Harold M. Lewis, New York City consultant and former chief engineer and planning officer for the New York Regional Plan Association.

Recent speakers before meetings of the Junior Branch of the Section have included Mark B. Owen, whose subject was "9,000,000 Jobs"; James B. Reid, in charge of production control for the magnesium division of the Dow Chemical Company, who discussed magnesium and its alloy; and A. J. Boase, manager of the structural and technical bureau of the Portland Cement Association, who spoke on "Reinforced Building Construction in South America.'

NORTH CAROLINA SECTION

The annual meeting of the North Carolina Section took place in Raleigh on January 27. Following a joint morning session with the North Carolina Society of Engineers, Ole Singstad gave an illustrated talk on problems of design and construction. Mr. Singstad is chief engineer of the New York City Tunnel Authority. Howard F. Peckworth, assistant to the Secretary of the Society, then spoke on employment conditions, reviewing the history of the movement and its present status. During the business meeting

that followed several committee reports were read and new officers were elected for the coming year. The result of the election was as follows: J. N. Stribling, president; R. M. Cooksey, vice-president; and G. H. Maurice, secretary-treasurer. Called to take the chair, Mr. Stribling made a brief speech of acceptance.

PHILADELPHIA SECTION

On February 17 members of the Philadelphia Section gathered for their annual social meeting, which as usual proved a high point in the year's activities. Between courses of the delicious dinner group singing was enjoyed, and later there was a program of music and dancing and an excellent balancing act, put on by a returned paratrooper. George T. Seabury, Secretary of the Society, then presented certificates of life membership to Carl de Moll, W. L. Fitzgerald, A. G. Nicolaysen, and A. J. Warlow. Two other recipients—Henry H. Garrigues and Lyle A. Whitsit—were unable to be present, and the seventh new life member, David L. Diehl, died on February 5. Later Lt. Col. Lester L. Lessig, who has just returned from a tour of duty in India, described some of his experiences there, and official Army and Navy films completed the technical program The rest of the evening was given over to social dancing.

PITTSBURGH SECTION

The principal speakers at the February meeting of the Pittsburgh Section were Park H. Martin, planning engineer for the Allegheny County Planning Commission, and E. L. Schmidt, district engineer for the Pennsylvania Department of Highways. They discussed various aspects of the postwar highway and bridge improvement projects that are being planned for Allegheny County. The meeting was a joint session with the Engineers' Society of Western Pennsylvania.

ROCHESTER SECTION

"Photography will play an increasingly important role in the world of tomorrow," Adrian L. TerLouw told the Rochester Section at its February 15 meeting. Mr. TerLouw, who is supervisor of the Eastman Kodak Company's Camera Club Service, envisages a greater stress on photography in schools to give students in science and engineering the knowledge of how to use photography to the fullest advantage. Photographic techniques, such as spectroscopy and radiography, once limited to the research laboratories, are now finding their way into the manufacturing plant for use in quality control and greater precision. Mr. TerLouw also touched on the field of geophysical exploration by photography, stating that locations of earth strata are determined by this means and citing one instance in the Antarctic where a large island was discovered by this means, though it was hidden under 400 ft of snow and ice. Oil, too, may be located by photography. His talk was illustrated by lantern slides.

SACRAMENTO SECTION

On January 2 Section President George E. Goodall presented the annual address which was entitled "The Progress of Engineering." At the first session of the annual meeting the following new officers were elected for the coming year: Everett L. Walsh, president; Conrad A. Ecklund, first vice-president; Robert L. Wing, second vice-president; and Edwin F. Sullivan, secretary. Also, during the meeting, Norwood Silsbee was awarded a book for his attendance at this, his thousandth, meeting The new officers were installed at the adjourned session of the annual meeting, which took the form of a dinner-dance on the 13th. The program on January 23 consisted of an inspection of the State Highway Materials and Research Laboratory under the direction of Thomas E. Stanton. Frank Kochis, principal engineer for the U.S. Engineer Office at Sacramento, spoke at the February 13 meeting on "Authorized Flood Control Projects in the Sacramento-San Joaquin River Basins." And on February 20 Bradshaw Harrison described a trip he had made to the Philippines in 1918, presenting the narrative for a modern film of the islands.

ST. LOUIS SECTION

Various business matters were discussed at the January luncheon meeting of the St. Louis Section. Then Joseph E. Vollmar, colonel, Corps of Engineers, U.S. Army, described recent overseas accomplishments of the Corps of Engineers. Colonel Vollmar, who recently returned from two years in England, described the circumscribed life of the British people during the war and urged better understanding between the Americans and the English in the interest of the future.

TRI-CITY SECTION

Numerous business matters were discussed at the January meeting of the Tri-City Section, which was held in Moline, Ill., on the 18th. An illustrated talk by Ralph Graham on "Public Works Operation and Maintenance" comprised the technical program. Mr. Graham is superintendent of construction and public works for the city of Davenport, Iowa. On February 23 members of the Section met at Davenport, Iowa, to hear Walter A. Rosenfield, director of public works for the State of Illinois, speak on highway problems.

VIRGINIA SECTION

During the annual meeting of the Section, which took place in Richmond on February 9, the following officers were elected for the coming year: Richard Messer, president; R. A. Marr, Jr., first vice-president; R. Stuart Royer, second vice-president; and Starr Truscott, third vice-president. P. A. Rice will continue as secretary-treasurer. Later in the evening Brig. Gen. James A. Anderson presented a certificate of life membership to E. L. Hastings, former Vice-President of the Society. The group then discussed matters affecting the economic and professional advancement of the engineer.

WISCONSIN SECTION

On January 25 members of the Wisconsin Section met in Milwaukee to hear A. G. Hoppe speak on the subject of diesel locomotives. Mr. Hoppe, who is assistant to the chief mechanical engineer of the Chicago, Milwaukee, St. Paul and Pacific Railway, traced the history of locomotive design from the past to the present with special emphasis upon costs of operation, maintenance requirements, and service life of the various types of prime movers. He then discussed the newer types of locomotives—diesel, electric and steam—as well as combinations of these. An enthusiastic discussion from the floor followed.

WYOMING SECTION

The annual meeting of the Wyoming Section was held in Cheyenne on February 23. Following the discussion of numerous business matters, the guest speaker, Roger Rhoades, geologist for the U. S. Bureau of Reclamation at Denver, Colo., was introduced. Mr. Rhoades spoke on the subject of engineering geology making specific reference to its application to concrete aggregates.

Student Chapter Notes

STANFORD UNIVERSITY

The Stanford University Chapter owns a transit which is available for rental to responsible persons. The revenue has been used in various ways under advice of the Faculty Adviser. Last year part of it went for the purchase of civil engineering books for the two-year-old engineering library, which is a consolidation of the departmental libraries and is housed in the main library. It is also planned to use funds derived from the rental of the transit to increase the principal of the civil engineering scholarship, which was established by Professor Emeritus Charles B. Wing in 1[illegible] with a gift of $4,000.

Description of the transit follows: Leitz, Serial No. 6079, with 6-in. horizontal plate reading to 30 sec of arc, two rows of figures graduated to 360 deg in each direction; 5-in. full vertical circle double vernier reading to 1 min of arc; direct-reading compass graduated in half degrees; $10^1/_2$-in. telescope, external focusing erecting image; tripod standard split leg, non-extension type.

In the past the rental charge has been $20 per month, payable monthly, or $5 per week. Arrangements for rental can be made through the Faculty Adviser, Prof. L. B. Reynolds, or the civil engineering department.

ITEMS OF INTEREST

About Engineers and Engineering

That Was Intramuros

By J. CHARLES RATHBUN, M. AM. SOC. C.E.

PROFESSOR OF CIVIL ENGINEERING, COLLEGE OF THE CITY OF NEW YORK, NEW YORK, N.Y.

TO THE DEPARTING soldier the best view Manila is from the stern of a transport. e ropes have been cast off, the military nd has played "The Girl I Left Behind ," and the men's faces have lighted up the thought of home. A two-, three-,

NTA LUCIA GATE IN THE OLD WALL OF INTRAMUROS, MANILA, P.I.

five-year term of service has ended and e boys take one last look at the city.

For the first few years of this century anila's skyline was dominated by the d wall of the Spanish city, Intramuros, ith the Augustinian Convent windows eeping over it near the Santa Lucia Gate. radually, tall, modern, concrete buildgs changed the view, so that by 1940 anila presented a skyline that any city ight well envy. Americans and Filipinos orking together had done a good job. ut for those of us who assisted in this ork in the early days, the old walled city, ntramuros, holds memories and is the real anila. And it is not devoid of interest those who have been trained as engieers.

Manila was first occupied by Europeans 1570. The site was then a swamp at the outh of the Pasig River, and no worse lace to support the construction to come ould have been found. Not only is the oil a river deposit but the ground-water evel during the typhoon season is often ell above the earth's surface. To build a all some 20 to 30 ft high, as well as massive stone buildings, on such a site required oth skill and courage. Necessity also elped a lot.

The site selected was virtually an island even during the dry season. It was ounded on the west by the sea, on the orth by the river, and on the south and ast by sluggish tidal streams (*esteros*) hich did their best to drain the land durng the rainy season.

Like the Great Wall of China, the city wall in the beginning was modest in design, but experience compelled repeated revisions. Fort Santiago was first built of logs in 1571, and so, it is claimed, is the oldest structure under the American flag. The wall was started in 1591 but did not reach perfection until 1872. It served well in a Chinese uprising in 1603, but it was then made clear that it needed enlarging and strengthening. The Spaniards needed protection from the natives as well as from the Sulus and Chinese. (The Chinese pirate Koxinga rose to power a few years later.)

In describing the wall as I saw it, I shall use the present tense, as recent news releases indicate that the wall, although shattered, will be preserved. This wall is

AUGUSTINIAN CONVENT JUST INSIDE SANTA LUCIA GATE

$2^3/_4$ miles long and in most places about 25 ft high and 40 ft thick. In a few places it is 29 ft high and 52 ft thick, while at the north end, where the fort is located, it is but 8 ft thick. It consists of a compacted fill with squared stone facings on both sides. The outer face has a heavy batter; the top is leveled off and its surface well drained. On the outer face of this top is a stone parapet $1^1/_2$ ft thick and breast high.

There are numerous rooms or dungeons in the wall which serve to lighten the load on the foundation. These rooms have, in the past, been useful as sleeping quarters for students, while educating those whose ideas differed from the ones of the party in power. The numerous skeletons in these dungeons give mute testimony to the difficulties educators often have with their pupils.

The stone facing of the wall is of volcanic tufa, which is quite soft when first quarried but which hardens after exposure to the air. This facing gives a very substantial appearance to the wall.

Some time after 1740 the streams on the south and east were enlarged to form a moat around the city. To protect the foundation of the wall, the moat was dug very shallow on the inner side, and the bottom was sloped gradually down to deep water on the outer. Even so, the foundation must have been materially affected although no serious evidence of settlement has been noted.

However troublesome the moat may have been to the wall foundation, it greatly simplified the sanitary disposal system. This stagnant body of water proved to be an almost perfect breeding ground for disease carriers, and the moat probably killed more people by indirect methods than the wall saved by direct. At each of the gates a movable bridge spanned the moat. These bridges were taken in and the gates closed each night from eleven till four, until as late as 1852. The Spanish might well have thought the town impregnable.

But in 1762 twenty-five hundred English soldiers occupied two stone churches just across the moat from the city and dropped 24-lb shot on the wall till a breach was made. The defending force was about a thousand Spaniards. The English stayed there two years. When they left the two churches were razed while the wall was repaired and greatly strengthened.

Soon after the Americans arrived in 1898 they filled the moat, seeded it to lawn, and renamed it a "sunken garden." They put a sewer system in Intramuros and made

OLDEST BUILDING IS THE AUGUSTINIAN CHURCH, FINISHED IN 1614

openings in the wall large enough to allow the waddling, clanging street cars to enter. And the "Walled City's" days as a fortress were over (almost).

The streets of Intramuros were laid out straight and at right angles to one another. At the west end of Calle Real was the gate of Santa Lucia. If one entered the city by this gate he found on the right the Augustinian Convent or Monastery ex-

HEAVILY REINFORCED ENTRANCE TO CONVENT—BELL TOWER IN BACK

tending for two blocks along each of the intersecting streets. On the left was the Archbishop's palace, a modern structure. In the next block, facing Calle Real and across the street from the convent, was the nunnery. The passageway between the convent and the palace was over the street.

The convent occupied some six acres of ground. It was in fact a walled city within a walled city. Here, free from the contaminating influences and temptations of the world (which includes women) the devout brethren lived a life of perfect peace and contemplation. From the outside it presented a most uninviting appearance, as the walls had the same massive stone construction which characterized the walls of the city. There were few windows on the first floor and these were high above the ground.

On the inside of the building the same heavy construction was maintained, but the presence of a formal garden broke the severity of the architecture. The great stone stairway and the stone dome were worthy of examination by those who enjoy and appreciate such structural feats of design and construction. The refectory (dining room to you) would easily seat a hundred and fifty people, while the recreation room was over 150 ft long. From the windows of the latter there was an excellent view of the city. The north windows looked across Calle Real. There were none on the first floor, and from the second floor the view was shut off for one block by the Archbishop's palace, a taller structure. However, the second block was occupied by the nunnery, a much lower building with windows on the first floor opening on the street. These windows were heavily barred.

On the west the windows of the convent were just high enough so that the observer could look over the wall and across the Bay to Corregidor. Imagine the thoughts of the monks on May 1, 1898, when they watched our modern navy sail into Manila Bay while an unfriendly people surrounded the convent walls.

The northeast corner of the convent grounds contained the Augustinian Church, the oldest building in Intramuros. It was dedicated in 1571, but the first structure was destroyed by an earthquake. The recent construction was designed by Juan Marcias and Lay Brother Antonio Herrera. Its construction was finished in 1614. Architecturally it was of the low arched Spanish Renaissance type. The foundation consisted of an inverted elliptical stone arch which supported the entire weight of the church. The ceiling was also a stone arch and nearly 4 ft thick. The horizontal thrusts of these arches were taken by heavy buttresses.

No mortar or cement was used in fitting the stones of either the church or the convent together. For over three hundred years these buildings successfully resisted earthquakes although cracks could be found in the ceiling of the church, and it is interesting to know that the changes in the width of these cracks were recorded through the centuries. The visitor did not need to use his imagination while examining this church. A padre told the following story to a tourist who duly recorded it in his travel book: "During a severe earthquake of my experience, the great stones of the ceiling rocked far enough apart to reveal the sky, but after the quake they all returned to their places."

With its floating foundation, stone dome, treacherous soil, heavy construction, and lack of mortar, this church, and the convent as well, should have attracted more attention than they did in engineering and tourist literature. The church, unlike the convent, was open to women.

A FORMAL GARDEN WITHIN THE AUGUSTINIAN CONVENT

At one time the convent held 250 people; it was designed to hold, with crowding, a thousand. During the recent occupation of Intramuros by the Japanese five to seven thousand civilians were imprisoned in this area. Later the men were taken out. Imagine the horror of those living, and that of the ghosts of those dead who had once lived in the convent in peace and quiet, to hear the voices of women and the prattle of children throughout the sacred halls. And in February of this year it was women, not monks, who looked out of the west windows across the Bay to Corregidor and watched our fleet sail in. And they must have wondered if rescue would come too late, for again an unfriendly people surrounded the convent.

In driving the Japanese out of Manila the Old City was reduced to rubble and Intramuros, from the Cathedral to the Silver Dollar Saloon, is a thing of the past.

The transports will soon be running again and if the old custom still prevails the band will play and the soldiers will go to the stern of the boat for a last look at the pile of ruins that was the "Pearl of the Orient."

[*All photographs are by the author.*]

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

THE APRIL SESSION of the Engineers Club will go down in the minutes as the most obstreperous in its history. The Professor started it by condemning engineers for their unimaginative and ultra-conservative terminology. "You preach that economy is the essence of engineering," he charged, "but your language is extravagant. One of your commonest materials is *reinforced concrete*, an 18-letter combination repeated in your reports thousands of times. Why not coin a single word, like *reincrete* or *reinbeton* or simply *recon*?"

Well, the argument wasn't recorded, but the vote stood: *reinforced concrete*, 169; *recon*, 1. "That proves my premise," insisted the Professor, "but I'll coin some terms for our problem. If a triangle is divided by a line thru one vertex so that equal circles may be inscribed in the parts, the line is a *cirmedian* and the circles are *subinscripts*.

"In these terms, our problem was to find an integral triangle with one side 400, so that area of the two subinscripts was 28% more or less than the area of the inscript, depending on which cirmedian was drawn. If that's clear to Joe Kerr, he can give us the wrong answer as usual."

"April fool!" shouted Joe, "I haven't any answer. I could see that the radii were related by

$$2\pi r^2 = (1 \pm 0.28)\pi R^2$$

where R is the inscript radius and r a subinscript radius. The $\pm$ sign gives

$$\frac{R}{r_a} = \frac{5}{3} \text{ and } \frac{R}{r_b} = \frac{5}{4}$$

which suggested the classical 3:4:5 triangle. But it doesn't fit."

"That was a good start, tho," admitted Cal Klater. "If Joe had known of cirmedians that

$$\frac{a}{s} = 1 - \left(\frac{R}{r_a} - 1\right)^2$$

for the general case, he would have found $a/s = 8/9$ and analogously $b/s = 15/16$. From this it follows easily that $a:b::s:s$ = 80–135–73–144. Only a can be 400 and the other two sides must be 675 and 365.

"Your simplicity makes that a perfect solution, Cal, but of course the triangle isn't perfect because the radii involved

...ical ($R = 10\sqrt{71}$, $r_a = 6\sqrt{71}$ and ... $8\sqrt{71}$). Perfection requires com...surability, which can be expressed in ...gers. For example, the isosceles tri...le with $a = 120$ and $b = c = 75$ has ... 20. The circumedian from A is 45, ...ding a into $60 + 60$ and making r_a = ... The cirmedian from B or C is 90, ...ding b or c into $42 + 33$ and making ... $r_c = 12$.

"Now there are an infinite number of ...h triangles and they can be found by a ...ple rule. I'd like you to find a perfect ...lene triangle, the smaller the better."

[Col Klater, singular this month, was ...chard Jenney. The new problem is ...ier than it sounds, easier than coining a ...ersal substitute for "reinforced con...te."]

New in Education

...t Columbia~

PLANS for the restoration of the normal ...gram of undergraduate study in the ...hool of Engineering at Columbia Uni...rsity have been announced by Acting ...an James K. Finch, M. Am. Soc C.E. ...finite steps affecting civilian enrolment ...ve been taken by the faculty in modify... the special Navy program followed ..., both civilians and Navy students ...ring the war years.

Beginning March 8, civilian students ... the first and second terms of this pro...m, and those new civilian students ...reafter admitted to the lower terms of ...dy, were transferred to a revived ...ular program of undergraduate study. ...is "new regular" program will be ...erated on the normal academic calendar. This change will be progressive, that is, ... each lower term of the present Navy-...ilian program is completed, it will be ...placed by the new regular program. ...e School of Engineering will thus be ...ering the accelerated Navy-civilian ...gram in the upper terms and a new ...ular non-accelerated civilian program ... the lower terms, until—presumably at ...e end of the summer of 1946—the Navy ...gram will have been completely dis...ced by the new regular curricula.

The change at Columbia has been made ...sirable at this time by the announced ...tention of the Naval authorities to dis...ntinue assigning new students to the ...12 program, while at the same time it ... their present plan to continue certain ...ups of these students, including the ...gineer specialist group, now enroled ... the V-12 courses, until the completion ... their courses of study.

EDITOR'S NOTE: *It is probable that no ...gle action will affect the civil engineering ...ofession to the extent that will the solution ...ched by the colleges for their problem of ...urning service men. Anticipating the ...nges in engineering education that will ...e place after the war—indeed even now are ...ing place—this special section is being ...vided in "Civil Engineering" for brief ...s and announcements.*

Canadian Engineers Disqualified by Court Decision

ONLY under the supervision of an architect are engineeers qualified to prepare plans for the construction or remodeling of buildings in the Province of Quebec, Canada. This decision was handed down by Justice O. S. Tyndale, of the Superior Court of Montreal, on January 26, 1945. Plaintiff in the action was the Province of Quebec Association of Architects, a small but active group in Quebec.

Suit was brought by the association of architects following design by Brian R. Perry, a professional engineer, member of the Corporation of Professional Engineers of Quebec, of a building at Lachine, Quebec. The building housed a machine shop owned and operated by the Harrington Tool and Die Company, Ltd.

Claiming that this did not constitute engineering work, the architect's organization brought suit. Its attorney testified, "Let the consulting engineer, like Perry, specializing in concrete or in electrical work, or other specialty, stay in his field as a consultant—let him wait until he is consulted by the architect or others."

"If a few engineers and big contracting firms can get the contract on their own terms, draw the plans and specifications, furnish some semblance of architectural service, and do the work in their own way, without the coordinating and integrating planning and supervision of an architect, the intent of the statute is flouted. The fees and the work of architects go to engineers and contractors, and the architect is ignored."

It was claimed by the plaintiff that this was the intent and meaning of the provisions of the Architect's Act passed in 1929. This position was upheld by the judge, who after throwing the defense evidence out of court, concluded that no building except lighthouses could be considered as "engineering works." Further, the judge established the necessity for the engineer designing a building to be "concerned" in the entire "work" of which his building is an accessory. Thus the structural engineer must also be responsible for the mechanical, electrical, or other functioning equipment housed by the building.

According to latest information, notice of appeal has been filed. A full account of the case, with the testimony submitted, is given in the February 1945 issue of *The Engineering Journal*, published by the Engineering Institute of Canada.

Wartime Engineering Manual

ENGINEERS interested in the type of construction made necessary by the scarcity of the usual building materials will find the wartime Engineering Manual of the Corps of Engineers helpful. The first chapters of this two-volume manual were published in 1942 to furnish a guide to the field construction agencies. Additional chapters were added during the ensuing two years, and continual revisions made to conform with the general war construction policies and the availability of construction materials.

Since the material situation was critical and constantly changing throughout the construction program, the manual was written and revised to represent the minimum use of critical materials consistent with safety.

The program for temporary construction, which is largely covered by the manual, is practically completed now. Thus no further publication of the manual is contemplated.

New York to Ithaca—and Back

ANOTHER example of the redoubtable spirit of engineers in facing wartime difficulties is vouched for by the Ithaca Section. Despite the fact that there were close to a hundred waiting to hear the talk by A. C. W. Siecke on "Salvaging the Normandie," which had been scheduled for the January meeting of the Section, the Lehigh Valley Railroad did not do its share; perhaps it did not "choose to run."

In any event, Mr. Siecke arrived in Ithaca at 11 p.m., some three hours late for the meeting. Unfortunately he had made reservations on the 11:45 train back to New York, and was thus only able to have a short drink of hot chocolate before reembarking.

Spending more than twelve hours on the trip from New York, including three hours at Sayre, Pa., is enough to discourage almost anyone, but Mr. Siecke graciously accepted the workings of fate and agreed to try it again "in the spring." Thus "when spring comes," the Section states, "if it ever does, we are assured of a most interesting talk."

Beach-Erosion Control Planned for Long Island

A $2,000,000 program to prevent progressive loss of beaches on Long Island, New York, is the subject of a recent report to New York's State Legislature. The report, submitted February 15, proposed that enabling legislation be prepared for construction of erosion-control structures, dredging, and restoration of protective formations.

Working for a year, the special committee found that erosion had advanced to a stage threatening loss of recreational and economic values. This condition was made more acute by the hurricanes of 1938 and 1944, when large sections of the coast were devastated.

Damage threatens beaches, inland waterway channels, property values, and the shellfish industry. This shellfish industry, amounting in 1944 to nearly six million dollars, is carried on in inner bays protected by barrier beaches which are particularly susceptible to erosion.

Specific recommendations are included in the report for construction of jetties, bulkheads, and fills. It is expected that the local authorities will make the necessary land available. Publication of the report, with many photographs and diagrams, by the legislative committee provides an excellent source for reference.

Cross Connections and Back Siphonage Subjects of National Research Council Report

War conditions have created new problems in cross connections of water supplies and in back siphonage caused by unusual installations. A comprehensive study made by the Committee on Sanitary Engineering of the National Research Council, was reported in its Sanitary Engineering Report No. 8, issued December 6, 1944. Excerpts from the report follow. Requests for the complete report should be sent to the National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D.C.

AS A CONSEQUENCE of unprecedented expansions, a number of public health disabilities were brought to the attention of the Committee on Sanitary Engineering, Division of Medical Sciences, National Research Council. Prompt review of the whole situation was desirable in order to eliminate such hazards as were detectable and to prevent future accidents.

With this objective in mind, the Committee appointed, in accordance with its usual practices, a Temporary Subcommittee on Cross Connections as follows: E. Sherman Chase, Joel I. Connolly, Francis M. Dawson, Raymond F. Goudey, Sol Pincus, and Warren J. Scott, Chairman. [All except Mr. Connolly are members of the Society.]

The Subcommittee was requested to review the situation prevailing in 1943; to scrutinize such rules and regulations as had been promulgated by military, semi-military, and civilian agencies; to recommend modifications in policies and in practice on the part of these control groups; and to summarize its conclusions and recommendations for needed action.

The Subcommittee has been at work over a period of approximately a year. Many of its recommendations have been the subject of negotiation with the military and other agencies, with resulting adjustments in policies, regulations, and practices.

CHANGED CONDITIONS IN WARTIME

The number of dangerous cross connection and back-siphonage-connection conditions has unquestionably increased owing to: (1) a large number of new industrial plants, (2) enlargements of old industrial plants, (3) changed processes in industrial plants, (4) demands for increased fire protection by war agencies, and (5) increased shipping activities. The speed necessary in wartime construction is a factor that may lead to oversight or neglect of necessary health precautions. The evidence is that the war impact may have entered this field especially in: (1) permanent cross connections for auxiliary fire-fighting supplies from unapproved sources, such as in industrial plants; (2) temporary cross connections for auxiliary fire-fighting supplies from unapproved sources either through "siamese" or other connections in factories, docks, or vessels; (3) permanent or temporary cross connections with auxiliary unapproved water supplies used for industrial work or during construction; (4) permanent or temporary cross connections with auxiliary unapproved water supplies used for pump priming or boiler feed in industries; (5) back-siphonage connections through submerged inlets in industrial process tanks filled with poisonous solutions; and (6) back-siphonage connections with plumbing systems or special service fixtures in new or enlarged industrial plants, hospitals, or other public buildings. The great increase in concentration of workers in factories and in the populations of our cities means that adverse effects from pollution of water will now be far more extensive than in peacetime.

The following are the conclusions and recommendations of this Subcommittee:

1. Steps should be taken to protect backflow connections between potable and non-potable water supplies, including those at pierheads and industrial water-using processes, and between potable water supplies and sewers or drains.

2. Personnel assigned to operating water-supply connections and equipment should be adequately instructed and should be supervised at all times; such personnel should be furnished a clear statement as to duties and responsibilities with respect to the protection and safety of the water supply.

3. Every connection with a plumbing system which will permit back-siphonage should be eliminated when possible; otherwise it should be provided with an approved type of vacuum breaker. Whenever there is possible occurrence of vacuum in a water pipe, means for rapid dissipation should be provided.

4. Every process water connection should be separated from the potable water supply. Process water connections should receive attention both within and without buildings and include connections to process water tanks and recirculating systems.

5. Every direct cross connection between potable water lines or apparatus holding potable water and sewers or drains should be broken, and air-gap separations should be used.

6. Where pipes for potable and non-potable water exist, such as in industrial plants or on vessels or docks, pipes should be so painted, posted, or otherwise marked as to be distinguishable readily; where possible, all outlets of non-potable water lines should be made unavailable for drinking. All shore connections into which fire boats may pump should have distribution systems separate from systems carrying potable water.

7. In many cases the inadequacy of pipe lines conveying water to pierheads from approved sources has tended to promote the use of unapproved auxiliary water supplies at pierheads. It is recommended that federal agencies institute a survey of water service and distribution pipe adequacies at pierheads.

8. During the war emergency, protection of the shore users near pierhead connections should be afforded at or near the property line on domestic and [illegible] lines carrying potable water.

9. In addition to protection at [illegible] property lines, backflow preventive devi[illegible] should be installed at each ship-side outl[illegible] whether for domestic or fire service.

10. All cross connections betw[illegible] potable and non-potable water supp[illegible] lines on vessels should be broken and [illegible] maintained, as outlined in the curre[illegible] regulations of the U.S. Coast Guard a[illegible] the U.S. Army.

11. The use of double check valv[illegible] as a method of prevention of backflow [illegible] inferior as a substitute for the use of [illegible] backflow preventer, even on 6-in. wat[illegible] lines or larger.

12. In connection with the use of t[illegible] "methods" referred to in the report, the[illegible] may be certain instances where speci[illegible] supplementary protection against vacuu[illegible] or against excessively high pressur[illegible] should be afforded to aid in backflow pr[illegible] vention.

13. All back-flow preventive devic[illegible] should be selected on the basis of approv[illegible] design supplemented by operating ex[illegible] perience under varying conditions, an[illegible] should be tested and approved by labora[illegible] tories of recognized national standi[illegible] with experience in this field.

14. Attention is directed to the nee[illegible] for careful installation of backflow pre[illegible] ventive devices to avoid introduction o[illegible] contamination by the devices themselve[illegible]

15. Effort should be made by federa[illegible] agencies to promote adoption of state an[illegible] local codes controlling water piping an[illegible] plumbing.

16. Local water, health, and buildin[illegible] departments should cooperate and estab[illegible] lish a coordinated program to investigat[illegible] and correct existing dangers from back[illegible] flow and to control new installations o[illegible] water and plumbing systems in buildings.

17. The appropriate federal agencie[illegible] should establish a unified national program [illegible] and work with state and local agencie[illegible] to correct and control dangerous backflow [illegible] conditions. Such a program should in[illegible] clude the principles and procedures out[illegible] lined in this report. Specific regulation[illegible] and instructions for responsible federa[illegible] personnel should be adopted, and thes[illegible] should cover instructions to the level o[illegible] the water foremen and engine-room [illegible] workers on vessels. Training courses for [illegible] personnel are needed and should be [illegible] established.

Safety Program Urged by Police Chiefs

THE INTERNATIONAL Association of [illegible] Chiefs of Police is deeply concerned with [illegible] the traffic accident outlook and the need [illegible] for increased efforts to conserve manpower [illegible] and transportation. News from the [illegible] fighting fronts supports the belief that it [illegible] is essential to act now to assure the maxi[illegible] mum war effort on the home front.

Many factors make the accident outlook [illegible] serious. Even with vehicular travel cur[illegible] tailed by war conditions there were more [illegible] fatalities due to travel in five of the first

months of last year than in the same ths of the preceding year. With no cars since early 1942, the age of ve- es becomes constantly higher and their eral condition grows steadily worse. day's cars are nearly twice as old, on an rage, as they were in prewar days. kewise, tires must be made to last longer n anticipated.

Realizing the threat of traffic accident es to the war effort, the President of the ited States called upon the Association mobilize the law enforcement agencies the nation to combat this problem. A ilar request was received from the airman of the National Committee for stwar Traffic Safety, a committee com- ed of 48 national organizations. Ac- dingly, steps are now being taken to pare for this emergency by uniting the ce, state and local, in a nation-wide cial-emphasis program.

The program, to be inaugurated April will bring forcefully to the attention of motorists the need for good brakes. ring the six weeks of the program, ce of the nation will check the brakes motorists involved in accidents and ving traffic violations. This check will made by a new and simple method ch does not waste tires, gasoline, or e. It can be done quickly and requires additional police manpower. Vigorous cational programs through posters, ets, and extensive publicity will sup- t police activity.

Outstanding results were obtained in large state where this procedure was owed. After a seven months' con- tive rise in traffic deaths, compared h the corresponding period of the pre- us year, fatalities were reduced 33% first month of the program and 31% second month, and there was a carry- reduction of 16% the month following close of the program.

Actually, the reduction in traffic fatali- in this state during the first month was ficient to cause a decrease nationally the first time in eight months. The % reduction for the second month con- sts with a 2% increase nationally.

n view of these accomplishments, we ieve such a program will focus public ention upon the overall condition of tor vehicles, the need for conservation, for safe driving practices.

Bulletin on Industrial Power

This 109-page publication—recently veloped by the American Institute of ctrical Engineers through its Commit- on Industrial Power Applications—is itled "Electric Power Distribution for ustrial Plants." The report analyzes service requirements, voltage-regula- problems, load characteristics, and tribution system characteristics, and it deals with the selection of equipment distribution systems. It is not an I.E.E. standard, and the recommenda- s are not intended to be mandatory or rictive.

Copies are available on application to I.E.E. headquarters, 33 West 39th et, New York 18, N.Y., at a cost of $1.

NEWS OF ENGINEERS

Personal Items About Society Members

HAROLD G. SOURS has announced the formation of a partnership with Eugene E. Baldwin—of the Columbus, Ohio, firm of Taylor and Baldwin—to handle highway materials and equipment. Engaged in highway work in Ohio for almost twenty-five years, Mr. Sours was until recently state highway director.

P. M. COOK, formerly assistant chief engineer for the Canadian Pacific Air Lines, has been appointed research engineer to the British Columbia Industrial Scientific Council to carry out scientific investigations on highway construction in the province. These investigations are being made at the University of British Columbia in cooperation with the Department of Public Works.

ARCHIE N. CARTER, associate editor of *Engineering News Record*, has been transferred from New York City to the Washington office of the McGraw-Hill Publishing Company, with headquarters in the National Press Building. Mr. Carter will act as regional editor with responsibility for reporting on technical developments in Delaware, Maryland, Virginia, West Virginia, and North Carolina.

CHARLES S. KEATING, consulting engineer for the City of Syracuse, N.Y., is retiring after twenty-three years in the service of the city. Mr. Keating's first position with the city was that of first deputy city engineer, and he later was appointed consulting engineer.

E. WARREN BOWDEN is now vice-president of Walter Kidde Constructors, Inc., of New York City. He formerly held the position of assistant to the president.

JOSEPH C. WEBBER, first lieutenant, Corps of Engineers, U.S. Army, was recently made commanding officer of an aviation engineer petroleum distribution unit in Italy. Prior to going into the Army, Mr. Webber was city engineer of Toledo, Ohio.

HARRY W. LOVING has severed his connection with the Office of Chief of Engineers, Washington, D.C., in order to become vice-president of the J. A. Jones Construction Company. He will head the New York and Washington offices and be in charge of public utilities and industrial work. Mr. Loving was recently awarded the emblem for Exceptional Civilian Service in his capacity as head of the Price Adjustment Branch, Readjustment Division, Office of the Chief of Engineers.

FRANK C. CAREY, lieutenant colonel, Corps of Engineers, U.S. Army, has been assigned to duty as engineer and demolition officer for the Panama Canal Department.

A. M. BRENNEKE, formerly office engineer for Pan-American Airways at Miami, Fla., has accepted a position with the Institute Nacional de Obras Sanitarias, an agency of the Republic of Venezuela, with headquarters in Caracas, Venezuela. Mr. Brenneke will assist in the modernization, rehabilitation, enlargement, and operation of the water-works systems of the country.

HAROLD S. HUTTON, sales manager for the Wallace and Tiernan Company, Inc., of Newark, N.J., was recently honored by his associates at a dinner celebrating his completion of twenty-five years with the organization. The dinner was sponsored by the W & T Diamond Club, composed of employees who have been in the service of Wallace and Tiernan for ten years or more.

GEORGE HAVAS has been elected vice-president and general manager of the newly organized Kaiser Engineers, which is made up of engineers long associated with Henry J. Kaiser and which will be available for engineering work in any part of the world. His headquarters will be in the Kaiser Building, Oakland, Calif.

FRANCIS L. CASTLEMAN retired on February 1 from his position as chief engineer of the Trenton (N.J.) plant of the American Bridge Company after forty-seven years of continuous service with that organization. For a time, however, he will continue to serve the company in an advisory and consulting capacity.

R. F. HOFFMAN was recently promoted from the rank of major in the Air Corps of the U.S. Army to that of lieutenant colonel. He is stationed at McDill Field, Florida.

EDWARD R. LACY, captain, Sanitary Corps, U.S. Army, has general supervision of sanitation and malaria control with the North Africa Air Transport Command.

JOSEPH H. KIMBALL has retired from his position as head of the flood control section of the Water Control Planning Department of the Tennessee Valley Authority, having reached the age when retirement is compulsory. Mr. Kimball, who has been on the staff of the TVA since 1933, will continue to serve the organization in the capacity of consultant.

VICTOR L. STREETER is now supervisor of fluid mechanics in the engineering mechanics division of the Armour Research Foundation, having been transferred there from the post of associate professor of civil engineering at the Illinois Institute of Technology.

RICHARD L. HEARN has been promoted from the position of executive assistant to the chairman of the Hydro-Electric Power Commission of Ontario to that of chief engineer in charge of design and construction. His headquarters are in Toronto, Canada.

CARLTON W. LINGHAM, assistant hydraulic engineer for the U.S. Geological Survey, was recently transferred from the Clewiston to the Ocala (Fla.) office of the Survey, where he is doing special reports on stream flow and preparing data for water-supply publications.

ROY F. BESSEY has been given a leave of absence from his duties as consultant

to the National Resources Planning Board, Pacific Northwest Regional Planning Commission, in order to serve as chief transportation officer of the United Nations Relief and Rehabilitation Administration in China.

FRANK PURDY, who is on the staff of the U.S. Geological Survey, has been transferred from Sacramento, Calif., to the Arlington, Va., office of the Survey.

T. J. KAUER, formerly assistant to the president and Washington representative of the American Concrete Pipe Association, was recently appointed assistant managing director of the organization. His headquarters will continue to be in the Munsey Building, Washington, D.C.

IRVING H. ROSEDALE is a recent recipient of the Navy's meritorious Civilian Service Award "in recognition of excellent services rendered in the Hawaiian Islands." Mr. Rosedale has been acting as assistant superintendent for the Pacific Bridge Company at Honolulu.

L. HAROLD ANDERSON has resigned as city engineer of Palo Alto, Calif., in order to accept Governor Warren's appointment as member of the California State Railroad Commission.

THOMAS F. CHACE, San Francisco consultant, is a joint recipient, with MYRON S. FALK, of the Navy meritorious Civilian Service Emblem "for their work in the design and expansion of Navy establishments in the Bay Area."

HARVEY L. VINCENT has been promoted from the rank of Chief Carpenter's Mate in the Seabees to that of warrant officer in the Civil Engineering Corps of the U.S. Naval Reserve. At present he is in the Officers' Replacement Pool at Camp Parks, Calif.

EDMUND A. PRATT, until lately manager of the Overseas Department of the Barber Asphalt Company, Barber, N.J., has joined the staff of the American Standards Association to assume direction of its Inter-American Department. This department was set up about two years ago to implement a program of inter-American cooperation in standardization. Mr. Pratt's headquarters will be in New York.

DECEASED

RUSSELL VINCENT BANTA (Assoc. M. '17) vice-president and chief engineer for Lockwood Greene Engineers, Inc., New York City, died at his home in Mt. Vernon, N.Y., on February 18, 1945. Mr. Banta, who was 56, was in private practice in New York from 1914 to 1918. After serving in the infantry in the first World War, he joined the Lockwood Greene firm. Since then his work had included the making of engineering plans for the main unit of the Herald-Tribune Building, the Daily News Building, and the McGraw-Hill Building.

CHARLES PHILIP BOWER (M. '07) retired engineer of Philadelphia, Pa., died on February 8, 1945, at the age of 73. For many years Mr. Bower maintained a railroad contracting practice in Philadelphia, retiring about three years ago.

DAVID LESLIE DIEHL (Assoc. M. '09) president of the Whittaker and Diehl Company, of Harrisburg, Pa., died at his home near Chambersburg, Pa., on February 5, 1945. Mr. Diehl, who was 63, was president of the Whittaker and Diehl Company for almost twenty years. Earlier in his career he had been president of the Simplex Construction Company, of Harrisburg. Just before his death Mr. Diehl was elected to life membership in the Society.

JAMES RUTHERFORD ELLIOTT (M. '04) associate engineer for the U.S. Engineer Department at Los Angeles, Calif., died on February 2, 1945, at the age of 71. Born in England, Mr. Elliott was educated in this country and spent his career here. For practically the entire period between 1907 and 1927 he was a member of the Pittsburgh (Pa.) consulting firm of Elliott and Baton, engaged on the design and construction of numerous coal facilities and operations. From 1927 to 1930 he was a partner in the firm of Elliott, Bowen and Walz, consulting engineers of Los Angeles, Calif., and from 1933 to 1937 he was city engineer of Riverside, Calif. Later he was associated with the firm of Davidson and Fulmer, of Riverside, and for the past two years he had been in the U.S. Engineer Office.

MERTON LESLIE EMERSON (M. '34) technical adviser for the Social Security Board, Washington, D.C., died in Alexandria, Va., on February 8, 1945. He was 62. An inventor in the field of pneumatics, Mr. Emerson had been manager of the Boston Pneumatic Transit Company and president of the American Pneumatic Service Company and its subsidiary corporations. Later he maintained a consulting practice in Boston, specializing in management engineering, and since 1940 he had been technical adviser for the Social Security Board in Washington, D.C.

EMILE HENRY HEILBRON (M. '23) Illinois Valley Engineer for the Sanitary District of Chicago, Chillicothe, Ill., was killed there on February 10, 1945, when a train struck his automobile. Mr. Heilbron, who was 72, had spent his entire career with the Sanitary District of Chicago, with which he became affiliated in 1892. Since 1906 he had lived in Chillicothe, representing the District in the Illinois River territory from Lockport to the Mississippi River. Mr. Heilbron made surveys of the Illinois that were used later as the basis of maps prepared by the U.S. Corps of Engineers and, also, kept track of overflow conditions on the river and subsequent developments.

JULES JOSEPH HENNEBIQUE (M. '19) consulting engineer of New York, N.Y., died on August 14, 1944, though the Society has just heard of his death. Mr. Hennebique, who was 71, was born and educated in Belgium. Coming to this country in 1902, he acted as vice-presi[dent] of the Hennebique Construction C[o]pany, of New York. Later (1906 to 19[10] he was chief engineer of the Inter[na]tional Construction Company, Mobile, A[la.] from 1915 to 1924, president and c[hief] consulting engineer of the Case Co[n]crete Protection Corporation, New York C[ity] and from 1924 to 1928, chief engineer [for] the Novocrete and Cement Produ[cts] Company, Ltd., London, England. [He] then established a private practice, and [for] several years was designer and consul[ting] engineer for the New York City P[ark] Department.

J. FREDERICK JACKSON (M. '16) co[n]sulting engineer of Hamden, Conn., [a] former chief engineer for the PWA [in] Connecticut and Rhode Island, died [in] Hamden in February 1945. His age [was] 73. From 1896 to 1909 Mr. Jackson [was] assistant engineer for the city of [New] Haven; from 1909 to 1913, consult[ing] engineer for Bridgeport and several Con[n]ecticut towns; from 1913 to 1915, [en]gineer member of the Connecticut St[ate] Board of Health in charge of investi[ga]tions of stream pollution; and fr[om] 1915 to 1925, director of the Connecti[cut] Bureau of Sanitary Engineering. Fr[om] the latter year to 1933 he maintained [a] private practice, specializing in water [and] sewerage problems. Mr. Jackson was [the] author of numerous works on sanita[ry] engineering subjects, and a member of [the] first executive committee of the Sanita[ry] Engineering Division of the Society.

ALFRED COOKMAN MARSHALL (M. '[16]) former president and general manager [of] the Detroit Edison Company, Detroit, Mich., died in a hospital there on Febr[u]ary 10, 1945, as the result of injur[ies] suffered earlier in a fall on the icy pav[e]ment. Mr. Marshall, who was 72, [was] with the Detroit Edison Company and [its] subsidiaries from 1894 until his retirem[ent] in 1944. During this period he was, [in] cessively, construction engineer; gener[al] manager of the Port Huron Light and Power Company; assistant to the pres[i]dent of the Eastern Michigan Edison Com[pa]ny; and vice-president and gener[al] manager of the Detroit Edison Compa[ny]. From March 1943 to May 1944 he [was] president of the Detroit Edison Compa[ny] and since his retirement from active du[ty] had served as a consultant and chairm[an] of the company's operating comm[ittee]. From 1920 on he was, also, a director [of] the company.

HUGH JOSEPH NOONAN (Jun. '42) [of] Peabody, Mass., died in 1944, at the [age] of 24. Following his graduation fr[om] Northeastern University in 1942, Mr. Noonan enlisted in the Air Corps of the U.S. Army. At the time of his death he had the rank of second lieutenant.

WILLIAM SCHUYLER POST (Assoc. M. '01) office engineer for the Pacific Nav[al] Air Bases, Port Hueneme, Calif., died at his home at Ventura, Calif., on Janu[ary] 24, 1945. His age was 73. He was b[orn] in Vienna, while his father was U.S. Con[su]sul General there. Mr. Post was educat[ed] here and served with the 316th Engine[ers] in the first World War, attaining the [rank]

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of major. Later he was hydraulic engineer for the California Water Resources Investigation; resident engineer for the city of Stockton, Calif.; consulting engineer for the Los Angeles County Flood Control District on the design of dams; and director of irrigation for the U.S. Indian Service in Washington, D.C. From 1935 to 1940 he was resident engineer inspector for the PWA, and from 1940 until about a year ago he was hydraulic engineer for the U.S. Engineer Department in Los Angeles.

EDWARD STEVENS RANKIN (M. '11) division engineer, Division of Sewers, Newark, N.J., died at his home in Glen Ridge, N.J., on March 8, 1945. Mr. Rankin, who was 84, had been in the employ of the city of Newark since 1887—for most of this period in the capacity of chief engineer of the Bureau of Sewers. A nationally known designer of sewage systems, Mr. Rankin was president of the American Society of Municipal Engineers in 1922, and recipient of that Society's first medal of honor in 1930. He was the author of two books used in the Newark public schools.

JOHN MCCLURE SALMON (M. '13) bridge engineer for the Louisville and Nashville Railroad, Louisville, Ky., died in that city on January 30, 1945, at the age of 66. From 1902 to 1903 Mr. Salmon was with the consulting firm of Brenneke and Fay, and from 1903 to 1906 with the Terminal Railroad Association of St. Louis. His first period of service with the Louisville and Nashville Railroad Company began in 1906 and extended to 1914, when he left to become chief engineer and general manager of the Louisville Bridge and Iron Company. In 1917 he returned to the Louisville and Nashville Railroad Company as bridge engineer, serving in that capacity until his death.

FRANKLIN CHADWICK SNOW (M '24) professor of civil engineering at the Georgia School of Technology, Atlanta, Ga., died there on March 1, 1945. He was 62. From 1909 to 1920 Professor Snow was assistant professor of civil engineering at Montana State College and, coincidentally, for part of this period he was also assistant city engineer of Bozeman, Mont., and consultant to the Montana State Board of Health. Since 1920 he had been at the Georgia School of Technology—since 1923 in the capacity of professor of civil engineering and head of the civil engineering department.

JOHN HERMON TERRY (M. '07) retired engineer and contractor, died at his h at Edgewater Park, N.J., on Febru 1945, at the age of 75. Mr. Terry re recently as president of J. H. Terry Company, engineering and contra firm of Philadelphia, Pa., with which had been connected for many ye As head of this firm, Mr. Terry su vised the design and construction of wharves, docks, and harbor facilitie the vicinity of Philadelphia.

SETH MORTON VAN LOAN (M. former chief of the Philadelphia (Bureau of Water, died suddenly at home in that city on February 7, 19 His age was 72. In 1901—after work the government and on the survey, des and construction of the New York S Barge Canal—Mr. Van Loan settled Philadelphia, where he was assistant gineer on plans for a municipal wa filtration system. When the city's Fi Bureau was merged with the Water B reau in 1918, he became general sup tendent of the Water Bureau. In 19 he was made deputy chief, and from 193 1942 he was chief engineer. About th years ago he was named chief engineer the city's $18,000,000 water-rehabilitat program.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From February 10, to March 9, 1945

ADDITIONS TO MEMBERSHIP

ABELSON, HAROLD NORMAN (Assoc. M. '45), Asst. Engr., 2d Nisqually, City of Tacoma, Alder, Wash.

ADAMS, JAMES TAYLOR (Jun. '44), Ensign, U.S.N.R.; 3622 Youree Drive, Shreveport, La.

ALK, LEWIS CHARLES (Assoc. M. '45), Chf. Engr., Foundry Dept., James B. Clow & Sons, Box 6600 A (Res., 6124 North Washtenaw), Chicago, Ill.

ALLIN, BENJAMIN CASEY (M. '45), Director, Greater Miami Port Authority, Box 4220, Miami 26, Fla.

ARONSTAM, MILTON SHELDON (Assoc. M.' 45), Civ. Engr., Corps of Engrs., 20 North Wacker Drive, Room 2001 (Res., 20 East Delaware Pl.), Chicago 11, Ill.

ASCHERMAN, JOHN CALVIN (Jun. '45), 909 South 1st, Apt. 15, Champaign, Ill.

ATKINS, FRANCIS STANLEY (Jun. '45), Junior Bridge Designer, Bridge Dept., State Dept. of Highways, Central Highway Bldg., Richmond, Va.

BENNITT, RALPH ANDERSON (M. '45), Cons. Engr., 51 East 42d St., New York 17, N.Y.

BONHAM, HOWARD EUGENE (M. '45), Associate, Paul A. Uhlmann & Associates, 2901 North High St., Columbus 2, Ohio.

BOWEN, WALTER CHARLES (Jun. '45), Junior Draftsman, Day and Zimmermann, Inc., Packard Bldg., Philadelphia (Res., 543 Folcroft Ave., Folcroft), Pa.

BOYNTON, ABRAHAM WEBSTER (Assoc. M. '45), Associate Engr., Federal Power Comm., Washington, D.C. (Res., 1512 North Utah St., Arlington, Va.)

BUCKNER, FLOYD KING (M. '45), Gen. Mgr., P. O'B. Montgomery, Box 923, Dallas, Tex.

BUETTNER, ROBERT PAUL (Jun. '45), With W. Ray Yount, Third National Bldg. (Res., 1102 Grafton Ave.), Dayton 5, Ohio.

CARTER, ROLLAND WILLIAM (Jun. '45), Asst. Engr., U.S. Geological Survey, Box 56, Montgomery, Ala.

CHADWICK, LEROI, CHARLES (Assoc. M. '45), Constr. Engr., R. J. Daum Constr. Co., Beason Bldg. (Res., 430 South 11th East), Salt Lake City 2, Utah.

CHANG, LEONARD IVAN (Jun. '45), 529 South Madison Ave., Pasadena 5, Calif.

CLARK, SHIELDS ERIC, JR. (Assoc. M. '45), Asst. Engr., U.S. Waterways Experiment Station, Box 631, Vicksburg, Miss.

CODY, JAMES MCDONALD (Assoc. M. '45), Chf. Petty Officer, U.S.N.; Box 113, Pell City, Ala.

COOP, BENNETT SUMNER, JR. (Assoc. M. '45), Engr., City Hall (Res., 1065 Deckner Ave., S.W.), Atlanta, Ga.

CRUTTWELL, CLEMENT HENRY (M. '45), Capt., Royal Engr., Chf. Engrs. Branch, 1139 Connecticut Ave., N.W., Washington, D.C.

DAMMANN, HARLOW (Assoc. M. '45), Valuation Engr., Navy Dept., Navy Bldg., Washington, D.C. (Res., 6114 Twenty-sixth St., North, Arlington, Va.)

DANA, ILIF ROSS, JR. (Jun. '45), Ensign, CEC, U.S.N.R., OTD, Naval Constr. Training Center, Camp Endicott, Davisville, R.I.

DAWSON, BERNARD MAURICE (Assoc. M. '45), Lt., CEC, U.S.N., Bachelor Officers Quarters 600, B211, Naval Air Station, Pensacola, Fla.

DOANIDES, PETER JOHN (M. '45), Care, The Greek Embassy, 30 Rockefeller Plaza, Room 1820, New York 20, N.Y.

DUBOWY, SAUL (Jun. '45), Private, U.S. Army; 942 Woodycrest Ave., New York 52, N.Y.

ESPINOSA PARGA, ROBERTO (Jun. '44), Box 2114, University Station, Gainesville, Fla.

FIORE, LOUIS PETER (Jun. '45), Seaman 1/c, U.S.N.; 47 Garden St., Ansonia, Conn.

FLYNN, HUGH FRANCIS (Jun. '45), Stress Analyst, Class A, Douglas Aircraft Co., Inc., 6551 West Manchester Ave., Los Angeles (Res., 115 South Ash Ave., Inglewood), Calif.

FRIEDMAN, HAROLD U. (Jun. '45), With U.S.N.; 1016 Fiftieth St., Brooklyn 19, N.Y.

FROMHERZ, THOMAS ALVIN (Jun. '45), Cadet-Midshipman, U.S.N.R.; 1430 Henry Clay Ave., New Orleans 15, La.

GARNER, HAROLD GLEN (Assoc. M. '45), Field Engr., Portland Cement Assn., 837 National Press Bldg., Washington 4, D.C.

GEHRI, EMIL FRED (Assoc. M. '45), Capt., Corps of Engrs., U.S. Army, Post Engr. Office, Camp Roberts, Calif.

GEIB, GEORGE ALBERT (M. '45), Cons. Engr., Federal Works Agency, Office, Ch 5124 Federal Works Bldg., Washington, D.C.

GIARDINA, DOMINICK ALBERT (Jun. '44), CEC, U.S.N.R.; 4014 Ave. K, Brooklyn N.Y.

GLASSGOLD, ISRAEL LEON (Jun. '45), Treas., Masonry Resurfacing & Constr. Inc., 2100 Huntingdon Ave., Baltimore Md. (Res., 4747 North 7th St., Philadel 20, Pa.)

GLEICH, DAVID (Jun. '45), 3086 West 1st Brooklyn 24, N.Y.

GOLDING, GEORGE WARREN, JR. (Jun. Naval Archt., Navy Yard, Bldg. 39, B (Res., 7 Adams St., Winter Hill 45), Mass.

GOODMAN, HUBERT LAWRENCE (Assoc. M. Post Engr., N.W.S.C., U.S. Army; 8210 Burn Drive, Bellaire, Tex.

GREEN, DAVID (Jun. '45), Ensign, CEC, U.S.N.R. Care, Fleet Post Office, San Fr cisco, Calif.

GREER, THEODORE BRADFORD (Jun. '45), (jg), U.S.N.; Box 373, Gallup, N.Mex.

GULDEN, HORACE BREAM (Assoc. M. '40), CEC, U.S.N.R., Care, Fleet Post Office, Francisco, Calif.

HALL, DAVID CRAWFORD (Jun. '45), 336 Fo St., Marietta, Ohio.

HARE, VAN COURT MONROE (Assoc. M. Senior Civ. Engr. (Chf. Engrs. Office), T 605 Union Bldg., Knoxville, Tenn.

HARSHBERGER, MARVIN LEONARD (Assoc. '45), Prin. Highway Engr., Public Roads ministration, Apartado Q., San Jose, C Rica.

HART, WILLARD HARRY (M. '45), Dist. Re Am. Inst. of Steel Constr., 735 North Wa St., Milwaukee 2, Wis.

HASSENFLUG, XENOPHON GEORGE (Assoc. '45), Vice-Pres. & Gen. Mgr., Pioneer Con Co., West End National Bank Bldg., Shaw (Res., 46 Rockglen Rd., Overbrook H Philadelphia 31), Pa.

HAYNES, HILLIARD GALBRAITH (Assoc. M. Associate Prof., Civ. Eng., The Citad Charleston, S.C.

HERSCHLER, LOUIS HORTON (Assoc. M. Civ. Engr., Board of Water Supply, Bos